DOCUMENT RESUME

ED 152 526 SE 023 991

AUTHOR Robitaille, David F.; Sherrill, James M.
TITLE British Columbia Mathematics Assessment, 1977. Report Number 2: Teacher Questionnaire-Instructional Practices.
INSTITUTION British Columbia Univ., Vancouver.
PUB DATE Sep 77
NOTE 174p.; Prepared for the Learning Assessment Branch of the Ministry of Education; For related documents, see SE 023 990-993; Contains occasional light and broken type

EDRS PRICE MF-$0.83 HC-$8.69 Plus Postage.
DESCRIPTORS *Educational Assessment; *Educational Research; *Elementary Secondary Education; *Instruction; *Mathematics Education; Needs Assessment; *Teacher Attitudes; Teaching Methods
IDENTIFIERS *British Columbia

ABSTRACT

As part of the 1977 British Columbia Mathematics Assessment, over 100,000 students from Grades 4, 8, and 12 were tested on a limited number of important mathematical skills and concepts. Approximately 3,500 teachers of mathematics at seven different grade levels (1,3,4,7,8,10,12) completed comprehensive questionnaires dealing with numerous aspects of the methods and materials in the teaching of mathematics in the province. This report is one of a four-part series and discusses the Teacher Questionnaire phase of the project. It contains a detailed exposition of the results of the questionnaire in terms of Teacher Background and General Information, Classroom Organization, Use of Textbooks, Classroom Instruction, and Learning Outcomes expected by the teachers. The Elementary Teacher Questionnaire and the Secondary Teacher Questionnaire are provided in the Appendix. (MN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED152526

BRITISH COLUMBIA MATHEMATICS ASSESSMENT 1977

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

Instructional Practices

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

James Sherrill

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

SE 023 991

2

A REPORT TO
THE MINISTRY OF EDUCATION
PROVINCE OF BRITISH COLUMBIA

The B.C. Mathematics Assessment

Report Number 2

TEACHER QUESTIONNAIRE

This report was prepared for the Learning Assessment Branch of the Ministry of Education by

David F. Robitaille
James M. Sherrill

MATHEMATICS ASSESSMENT CONTRACT TEAM

David F. Robitaille (Chairman) - Faculty of Education, U.B.C.
James M. Sherrill - Faculty of Education, U.B.C.
Heather Kelleher - Teacher, New Westminster, S.D.
John Klassen - Teacher, North Vancouver, S.D.

September 1977

British Columbia Cataloguing in Publication Data

Robitaille, David F.
Teacher questionnaire.

(British Columbia Mathematics Assessment. Report ; no. 2).

Prepared for the Learning Assessment Branch of the Ministry of Education.
ISBN 0-7718-7002-7

1. Mathematics - Study and teaching - British Columbia. I. Sherrill, James M. II. British Columbia. Ministry of Education. Learning Assessment Branch. III. Title. IV. Series.

QA14.C3R6 372.7'09711

The British Columbia Mathematics Assessment

Management Committee

Robert Aitken (Chairman)	Learning Assessment Branch Ministry of Education
Olga Bowes	Learning Assessment Branch Ministry of Education
Helen Casher	School Trustee Maple Ridge School District
Ralph Gardner	Supervisor of Instruction Coquitlam School District
Gary Mitchell	Teacher Cranbrook School District
Jerry Mussio	Learning Assessment Branch Ministry of Education
Linda O'Reilly	Teacher Vancouver School District
David Robitaille	Faculty of Education University of British Columbia
James Vance	Faculty of Education University of Victoria

TABLE OF CONTENTS

		Page
1.	Introduction	1
2.	Teacher Background and General Information	11
3.	Classroom Organization	23
4.	Use of Textbooks	33
5.	Classroom Instruction	73
6.	Learning Outcomes	111

Appendices

A.	Elementary Teacher Questionnaire	131
B.	Secondary Teacher Questionnaire	155

CHAPTER 1

INTRODUCTION

In the spring of 1977, students enrolled in Grades 4, 8, and 12 in the public schools of the province of British Columbia took part in the Assessment of Student Learnings in Mathematics conducted by the Learning Assessment Branch of the Ministry of Education. During the same period, approximately 3500 teachers of mathematics at seven different grade levels completed a comprehensive questionnaire dealing with numerous aspects of the methods and materials used in the teaching of mathematics in the province. The Learning Assessment Program is longitudinal in nature, and the various aspects of the curriculum of the public schools are scheduled to be assessed at regular intervals.

One of the major purposes of this assessment of mathematics in the province was to collect baseline data against which the performance of students in future assessments could be compared.

1.1 Purposes of the Assessment

The major principle underlying the entire Learning Assessment Program is that decisions about education should be based upon an understanding of what and how children and young adults are learning. Educational decisions are being made every day, decisions which affect the allocation of resources, in-service education of teachers, teacher training programs, curriculum development and the adequacy of various programs. The Mathematics Assessment will provide decision-makers at all levels with factual and current information concerning the teaching and learning of mathematics upon which to base their decisions.

The Assessment Program in general, and the Mathematics Assessment in particular, are designed to inform the public of some of the strengths and weaknesses of the public school system in this province. The information generated by the Mathematics Assessment will assist school districts in maintaining identified strengths and overcoming weaknesses. It is hoped that curriculum developers and curriculum revision committees will be able to make use of these results in the process of improving curriculum and developing suitable resource materials. Furthermore, such information could be used in the allocation of resources at both the provincial and district levels.

At the university level, the information generated by the Assessment will be useful in indicating directions for change and improvement in teacher education. Finally, the information produced by the Assessment should be of great value to educational researchers both as a data bank and as a source of researchable questions concerning the teaching and learning of mathematics.

1.2 Organization of the Assessment

Several groups participated in the organization and implementation of the Mathematics Assessment. These groups included the Learning Assess-

ment Branch of the Ministry of Education, the Contract Team, the Management Committee, and the B.C. Research Council and several others with whom consultations were held.

The Contract Team was retained by the Learning Assessment Branch to conduct the Mathematics Assessment. The Contract Team's responsibilities included conducting the Goals Assessment and developing the set of objectives to be assessed, constructing the student tests, trying out the tests, and subsequently revising them, constructing the Instructional Practices questionnaire, and writing the final reports of the Assessment. The Contract Team consisted of two members of the Faculty of Education, University of British Columbia, a primary teacher who was on leave of absence from the New Westminster School District, and a teacher of secondary mathematics from the North Vancouver School District.

It was the role of the Management Committee to oversee the operations of the Contract Team and to provide guidance and suggestions regarding the various phases of the assessment. Members of the Management Committee included two teachers, a supervisor of instruction, a teacher educator, a school trustee, the chairman of the Contract Team, and representatives of the Learning Assessment Branch.

The B.C. Research Council conducted the majority of the technical and administrative aspects of the Assessment under the supervision of the Contract Team. Their responsibilities included overseeing the printing and distribution of the tests, answer cards, and teacher questionnaires, conducting the scoring and data analysis, and serving as statistical consultants and advisors to the Contract Team and the Management Committee.

Consultative meetings were held with several groups. Representatives of the Contract Team met twice with the Mathematics Curriculum Revision Committee to discuss aspects of the Assessment. In addition, Review Panels were organized by the Learning Assessment Branch to discuss the objectives to be tested in the Mathematics Assessment. Such panels were intended to be as widely representative as possible of the various groups interested in the mathematics achievement of students. Finally, meetings were held and correspondence exchanged with representatives of other assessment programs in North America, in order that the B.C. Mathematics Assessment could benefit from their experiences.

1.3 Components of the Mathematics Assessment

The Mathematics Assessment consists of four major components: the Goals Assessment, the Assessment of Student Learnings, the Interpretive Analysis, and the Inventory of Instructional Practices. The first three form the substance of a separate report (See Report Number 1 - Test Results) and will not be discussed in great detail here. However, brief descriptive comments about each of the four components are given in this section.

1.3.1 The Goals Assessment

It was not the objective of the Mathematics Assessment to attempt to evaluate students' achievement in mathematics in any particular course or program, or to evaluate the entire mathematics curriculum. Neither was it the objective of this assessment to obtain information on the achievement of individual students or schools, or on the performance of teachers of mathematics. It was the objective of the assessment to obtain, and to make widely known, information regarding the present state of mathematics learning on a province-wide basis. In addition, each school district would be provided with a summary of its own results.

The initial and basic decision as regards the Goals Assessment was to limit the scope of the content areas of mathematics to be assessed to those which most informed observers would agree were among the essential concepts and skills of mathematics at the three levels tested: end of primary education (Grade/Year 4), end of elementary education (Grade 8), and end of public schooling (Grade 12). Three levels of cognitive behaviour, called domains in the assessment, each subdivided into a number of objectives made up the basic framework of the Goals Assessment.

The process of identifying the specific concepts and skills to be assessed was based primarily upon the recently revised curriculum guide for mathematics in British Columbia. In addition to this basic document, several other sources were consulted and utilized. Chapter 2 of the Test Results report contains a detailed exposition of this procedure, as well as of the rather extensive consultation that took place throughout the Goals Assessment phase of the project.

1.3.2 The Assessment of Student Learnings

Tests were constructed to measure students' mastery of the objectives identified in the Goals Assessment phase. A separate test was prepared for each of the three grade levels involved. For each test, a total administration time of ninety minutes was allotted: thirty minutes for instructions, distribution and collection of the test booklets and answer cards, and sixty minutes for completion of the test.

Pilot testing of the assessment instruments was conducted during the late fall of 1976 in several school districts across the province. Approximately 250 students at each of the three grade levels involved wrote the tests, and their results were used in deciding upon the final form of the tests.

On the basis of the pilot testing certain items were deleted, others were added, and still others were modified. The majority of modifications to items represented efforts to improve the readability of the stem of an item or the plausibility of the distractors. All

additions and modifications were then tried out before being included in the final versions of the tests.

A second purpose of the pilot tests was to ensure that students had sufficient time in which to complete the tests since they were not intended to be speed tests. Results show that the majority of students at each grade level required significantly less than the total time allotted, and that virtually everyone was able to complete the test in less than one hour.

With the exception of a portion of the Grade/Year 4 test, all of the test items were presented in multiple-choice format with five foils or distractors for each item. In every case, the foils consisted of four possible answers to the item while the fifth foil was "I don't know". The "I don't know" option was used in an attempt to minimize guessing and in order to provide an outlet for students who, for one reason or another, had not been exposed to the material being tested or had forgotten it.

In an effort to assess change in students' abilities to deal with certain concepts and skills, some items appeared on two or more of the tests. For example, the same five items dealing with knowledge and understanding of the units of the metric system of measurement were used on all three tests. In several of the skill areas, the same items appeared on the Grade 4 and 8 tests, or on the Grade 8 and 12 tests. Overall, there were nine items common to the Grade 4 and 8 tests and forty-three items common to the Grade 8 and 12 tests. Of the foregoing, five items were common to all three tests.

The International System of Units (SI) was utilized for all test items involving measurement; no items contained British or Imperial units of measurement. Furthermore, any numeral containing five or more digits was written with a space between periods rather than a comma (43 256 not 43,256) and any decimal fraction with absolute value less than one was written with a zero before the decimal point (0.86 not .86), except in the case of computation items.

The decision to use the metric system of measurement exclusively did restrict, to some degree, the number and the nature of problem-solving items involving measurement concepts. For example, it was felt that including items dealing with the purchase of consumer goods such as carpeting, or concrete, or the like, in terms of metric units of area or volume would make such items appear overly unrealistic and unfamiliar since these terms and units are not yet in widespread use by consumers in our society. On the other hand, since the curriculum guide does call for implementation of the metric system of measurement in the schools, any reference to the British system was avoided.

One section of each of the three student tests was included to obtain information on certain aspects of student background.

These consisted of a number of factors which were either known to be or were strongly suspected of being related to students' performance in mathematics. Students at all three levels were asked to report on their age, sex, number of schools attended, length of residence in Canada, language spoken, and use of hand-held calculators. Grade/Year 4 students were also asked how many hours of television they watched each day. Grade 8 and 12 students reported how much time they spent on homework in mathematics, and whether or not their mathematics courses were semestered. Grade 12 students were also asked about the nature and extent of any employment they had, their future plans, and their parents' educational level.

Assessment tests in Reading were also given at the Grade 8 and 12 levels, and these tests contained similar, and in some cases identical, background and information questions. For example, on both the Reading and the Mathematics tests, students were asked their date of birth, sex, and number of schools attended. Because of the common items, it was possible to merge the two sets of data and obtain a new data file containing the information and results obtained on both of the tests. Matches were obtained for 66% of the Grade 8 students and 63% of the Grade 12 students. This new file was used to obtain further information on student background, as well as to correlate some aspects of student performance in reading with the same student's achievement on some of mathematics objectives. For example, it was then possible to obtain a measure of the correlation that exists between reading comprehension and the ability to solve mathematics problems.

While it would not be possible to identify causal relationships between such student characteristics and performance on the basis of the Mathematics Assessment data, it is possible to identify variables that appear to be related on the basis of the data collected. Relationships so identified may lead to follow-up studies specifically designed to identify cause and effect relationships on the basis of the correlational results discovered in the assessment program.

1.3.3 Interpretive Analysis

As part of the Language B.C. project which took place during 1976-77, the Learning Assessment Branch assembled a panel of eleven educators and assigned them the task of interpreting the assessment results. Such an approach to the interpretation of assessment results is not without its problems: the procedure is necessarily subjective in nature, the panel members may not be truly representative of the various groups having an interest in the results, and furthermore, such an analysis might give a false impression of precision or exactitude by assigning numerical values to decisions based on such subjective information.

On the other hand, no assessment program would be complete without some type of interpretation of the raw data. Since no

standards for comparison exist at the present time, some form of Interpretation Panel would appear to be the only choice available.

For that purpose three fifteen-member Interpretation Panels, one for each of the three grade levels involved, were constituted by the Learning Assessment Branch. Each panel consisted of seven teachers of mathematics at the particular grade level, two supervisors of instruction, two teacher educators, two school trustees, and two members of the public at large.

The information gained from the deliberations of the Interpretation Panels was used by the authors of this report in commenting upon the results of the assessment. Although the procedure used does lack some air of precision attributed to strictly numerical comparisons, the wealth of experience which the members of the panels brought to bear upon their examination and interpretation of the results gives their interpretations considerable credibility.

1.3.4 Teacher Questionnaire

Two questionnaires, one for teachers of elementary school mathematics and the other for teachers of secondary mathematics, were developed for use in the Mathematics Assessment. The questionnaires, which were completed anonymously, dealt with various aspects of the teachers' backgrounds and training as well as with facets of the methodology of teaching mathematics at different levels and with instructional practices used by teachers of mathematics.

Samples of potential questionnaire respondents were systematically selected on the basis of information provided annually by teachers to the Ministry of Education on Form "J". Every attempt was made to ensure that only teachers of mathematics received the questionnaire. Furthermore, since assessments in Reading and Social Studies were being conducted at the same time as the Mathematics Assessment, an effort was also made to ensure that no teacher was asked to complete questionnaires for more than one of the assessments. Further detail on the structure of the teacher sample is contained in the Technical Report.

Four elementary levels, 1, 3, 5, and 7, and three secondary levels, 8, 10, and 12, were utilized for the questionnaire. At each elementary level, questionnaires were sent to twenty-five percent more teachers than were required in order for the results to be interpretable as the opinions of the entire population of teachers of mathematics at that level. For example, given the number of teachers of mathematics that there are at the Grade 5 level, 625 questionnaires were sent out and 561 were returned, which was more than enough for the results to be interpreted as representing the opinions of the entire population of teachers of Grade 5 mathematics. The data on numbers of questionnaires sent out and returned are summarized in Table 1-1.

Table 1-1
Questionnaire Completion Results

Grade/Level	Questionnaire		
	Sent Out	Returned	% Completed
1	625	532	85.1
3	625	521	83.4
5	625	561	89.8
7	625	530	84.8
Total Elementary	2 500	2 144	85.8
8	489	420	85.9
10	361	292	80.9
12	101	99	98.0
Total Secondary	951	811	85.3

At each level the return rate exceeded eighty percent. This very high rate of return on the questionnaire was gratifying and adds credibility to the results. Teachers seem to have taken the questionnaire seriously, and they are to be congratulated for their efforts in completing what was a lengthy and comprehensive survey instrument.

1.4 Structure of the Questionnaire

Although separate questionnaires were prepared for the elementary and secondary levels, they shared the same structure and many identical items. Each questionnaire consisted of five parts: background and general information, learning outcomes, classroom organization, classroom instruction, and use of textbooks.

Part I, Background and General Information, contained a number of items dealing with teachers' academic and professional training, length and nature of teaching experience, and membership in professional associations. In addition, teachers were asked to rate various areas of the curriculum as to their importance for students' success in school as well as in adult life. Finally, secondary teachers were asked to rate how much they enjoyed and how difficult they found it to teach mathematics at various secondary levels.

In Part II, Learning Outcomes, teachers were asked to rate the importance of each of a number of objectives from the Mathematics Curriculum Guide list of objectives for their grade level. In addition, all teachers were asked to rate the importance of each in a list of objectives which students could be expected to have mastered upon completion of secondary school and secondary teachers rated a number of objectives for students completing elementary school.

In Part III, Classroom Organization, teachers reported on class size, length of teaching periods for mathematics, and time spent in preparation

and grading. They were also asked to indicate the nature of their classroom situation, use of various grouping practices, and the nature and extent of use of different student activities.

Part IV, Classroom Instruction, was designed to collect information on the resources, aids, and methods teachers use for the teaching of mathematics. This section contained several items dealing with teachers' and students' use of hand-held calculators.

Part V, the last section of the questionnaire, was concerned with the use of textbooks for the teaching of mathematics. In addition to stating which textbooks they were using, teachers were asked to indicate how satisfied they were with various aspects of the prescribed texts and how they used mathematics texts with their classes.

Overall, the elementary questionnaire consisted of fifty-four items for teachers of Grade 1, 3, 5, or 7 mathematics. The secondary questionnaire was designed for teachers of Grades 8, 10 or 12 and included sixty-five items.

Many items were included on the questionnaires for several different grade levels. For example, all of the elementary teachers surveyed (i.e., Grades 1, 3, 5, and 7) were asked to rate the importance of several subject areas, including mathematics, to the students' success in school. A footnote to Table 2-7 which presents the data on this question states that there was a significant difference at the 0.05 level among the grade-level groups who responded to this item, and a similar footnote is to be found following many of the tables throughout this volume. The footnote means that there was a difference in the way the grade-level groups responded to the item, and that this difference was large enough that there is less than five percent chance (0.05) that the difference is due to sampling error. With samples the size of the ones in this study, any difference in excess of approximately 0.2 would be statistically significant at the 0.05 level.

CHAPTER 2

TEACHER BACKGROUND AND GENERAL INFORMATION

Questions concerning the nature and extent of teachers' professional training, their teaching experience, professional activities, and opinions regarding the relative importance of various areas of the curriculum constituted Part I of the teacher questionnaire. The teachers' responses to these questions are discussed in this chapter.

2.1 Nature and Extent of Professional Training

2.1.1 Elementary Teachers

According to the questionnaire results, teachers of mathematics at the four grade levels sampled have an average of just over four years of post secondary education. There is some variation among the grade levels as can be seen from Table 2-1.

Table 2-1
Elementary Teachers:
Years of Post-Secondary Education (Percent)

No. of Years	Grade 1	Grade 3	Grade 5	Grade 7
1	0.4	0.2	0.4	0.0
2	7.9	7.1	2.9	1.2
3	33.9	26.1	18.0	10.7
4	40.2	41.0	34.3	24.7
5	15.4	20.0	34.5	42.1
6 or more	2.2	5.7	10.0	21.2

In general, the number of years of education increases with grade level taught. Over sixty percent of the Grade 7 teachers of mathematics have five or more years of post-secondary education while only about seventeen percent at the Grade 1 level have a similar amount.

Slightly less than thirteen percent of the elementary teachers have mathematics as one of their major subject areas in their undergraduate training. This finding ranged from a low of eleven percent for Grade 1 teachers to about eighteen percent for Grade 7 teachers. In response to a related item, approximately one quarter of the teachers indicated that they had not taken any mathematics since completing secondary school. Here also, the results varied with grade level -- from a high of 27.7% of Grade 1 teachers who had no post-secondary mathematics background to a low of 19.6% at the Grade 7 level.

More than one teacher of elementary mathematics in every ten, 13.7%, has never had a course in the teaching of mathematics, and another 35% has not had such a course in the past ten years. Significantly more teachers at the Grade 7 level have <u>never</u> had a mathematics methods course (17.4% vs 10.1%).

Recommendation 2-1: The Ministry of Education and individual school boards should require that all persons teaching mathematics at the elementary school level should have as a required part of their training the equivalent of at least one course in the teaching of mathematics and one course in mathematics for teachers.

2.1.2 Secondary Teachers

On the average, teachers of secondary mathematics at the three levels surveyed have had slightly more than five years of post-secondary education. The data relative to this question are presented in Table 2-2.

Table 2-2
Secondary Teachers:
Years of Post-Secondary Education (Percent)

No. of Years	Grade 8	Grade 10	Grade 12
1	0.0	0.4	1.1
2	0.8	0.0	0.0
3	2.1	1.1	0.0
4	9.7	5.8	1.1
5	57.2	54.2	59.6
6 or more	30.3	38.5	38.2

As with the elementary teachers, there is a tendency for the number of years of post-secondary education to increase with grade level taught. Grade 12 teachers of mathematics tend to have more years of education than either the Grade 8 or 10 teachers do, although the between-group differences are not as great as they were among the elementary teachers.

Surprisingly, almost thirty-five percent of these secondary teachers indicated that mathematics was not one of their major subject areas in their undergraduate training. This finding ranged from a high of almost fifty percent at the Grade 8 level to a low of seven percent at Grade 12. In other words, a fairly large proportion of those teaching mathematics at the secondary school level did not specialize in mathematics at university and most such teachers are working with students at the junior levels where the foundations for secondary mathematics are laid.

The situation with regard to training in methods of teaching mathematics is, perhaps, cause for even more concern as the data in Table 2-3 show.

Twenty percent of the teachers of secondary mathematics who

responded to the questionnaire indicated that they had never taken a course in the teaching of mathematics. Another 37% took such a course more than ten years ago.

Table 2-3
Secondary Teachers:
Percent Who Have Taken a Mathematics Methods Course

	Grade 8	Grade 10	Grade 12
Yes	72.0	8[illegible]	95.4

Recommendation 2-2: The Ministry of Education and individual school boards should require that all persons teaching mathematics at the secondary school level have mathematics as one of their major areas of study in their undergraduate training and a course in methods of teaching mathematics. This recommendation is important at all levels, but particularly at the junior secondary ones.

2.2 Teaching Experiences

The results reported on teaching experience are based on grouped data and are therefore approximations of the true figures. All reported means are conservative estimates: i.e., the true means are almost certainly somewhat greater than those reported.

The average number of years of teaching experience among the elementary teacher respondents was 8.5 years; for their colleagues at the secondary level the average was 9.2 years. Grade 12 teachers of mathematics had the highest average number of years of teaching experience, 11.1, and Grade 5 teachers the lowest at 8.3 years. Just over one fourth of the elementary teachers and one third of the secondary teachers had more than thirteen years of experience. Less than six percent of either group were in their first year of teaching.

2.3 Professional Activities

2.3.1 Membership in Professional Associations

Teachers were asked to indicate to which of a number of professional associations they belonged. These results are shown in Table 2-4.

With the notable exception of membership in the Primary Teachers Association, membership in professional societies is very low. It is particularly worrisome to note that at both the primary and intermediate levels membership in associations specializing in the teaching of mathematics is virtually non-existent. At the secondary

level, where teachers specialize in one or two teaching areas, the membership rates are still not very high.

Table 2-4
Membership in Professional Associations (Percent)

Association*	Primary	Intermediate	Secondary
BCAMT	2.9	2.8	27.7
NCTM	0.3	1.2	10.3
PSA	0.7	1.6	21.8
PITA	3.5	25.6	n/a
Primary	56.0	1.7	n/a

* BCAMT is the B.C. Association of Mathematics Teachers, NCTM is the National Council of Teachers of Mathematics, PSA is the local specialists association for mathematics, PITA is the Provincial Intermediate Teachers Association, and Primary is the B.C. Primary Teachers Association.

Directors of the various associations, particularly the specialist ones, might do well to consider the services their associations are offering teachers at various levels. In particular, it may be that elementary teachers either rightly or wrongly see little advantage in belonging to a specialist association.

At the same time, it would be unrealistic to expect each teacher to belong to several subject-related associations. In the case of an elementary school, rather than expecting several teachers to join an association such as NCTM, the school could apply for group membership and the benefits of such membership could then be shared by the staff.

Recommendation 2-3: Rather than expecting each elementary teacher to join several subject-matter specialist associations, schools should apply for group membership in such associations thereby making many of the benefits of membership available to all teachers on the staff.

Another way in which teachers can become informed about current developments in the teaching of mathematics is through attendance at conferences, workshops, or in-service days. Two items on the questionnaire asked teachers to indicate whether or not they had participated in such activities in the last three years. The results are shown in Table 2-5.

Table 2-5
Participation in Recent Conferences and In-Service Activities (Percent)

	Grade Level						
	1	3	5	7	8	10	12
Attended a conference Math session	67.1	60.1	49.6	54.6	52.2	65.6	83.1
Attended a non-conference Math workshop	70.8	65.7	58.5	61.9	55.6	64.6	74.2

At the primary and senior secondary levels, attendance at mathematics conference sessions and in-service days is significantly more common than at the Grade 5, 7 and 8 levels. The Grade 8 level, it will be remembered, is the one with the highest concentration of secondary teachers of mathematics with no university-level background in mathematics or the teaching of mathematics. It is also true that Grade 8 mathematics teachers have the lowest rate of membership in professional associations of the three secondary level groups who were surveyed.

2.4 Opinions Regarding the Teaching of Mathematics

2.4.1 Elementary Teachers

Teachers of Grades 1, 3, 5, and 7 were asked to respond to three statements concerning their feelings about the teaching of elementary school mathematics. For each statement, they were asked to select a point on a five-point scale ranging from "Strongly Agree" which had a value of 5, to "Strongly Disagree" which had a value of 1. The data obtained are summarized in Table 2-6.

Table 2-6
Elementary Teachers:
Opinions About Teaching Mathematics

	Mean Value				
Mathematics is my ...	Grade 1	Grade 3	Grade 5	Grade 7	Overall
(a) favourite subject to learn	2.8	2.8	2.8	3.1	2.9
(b) favourite subject to teach	3.6	3.9	4.2	4.3	4.0
(c) easiest subject to teach	3.4	3.6	3.9	3.9	3.7

Clearly, a great many elementary teachers considered mathematics one of the easiest subjects to teach as well as one of their favourite subjects to teach. However, they did not enjoy learning mathematics as much as they enjoyed teaching it. The fact that many of those who responded positively to statements (b) and (c) were among those without any post-secondary training in mathematics or the teaching of mathematics raises the question of what these teachers considered to be the important aspects of teaching and learning mathematics at this level. Some light is shed on this question in Section 6.1 of Chapter 6 which summarizes teachers' ratings of the relative importance of various curricular objectives in mathematics.

Teachers were then asked to rate eight areas of the curriculum, once again on a five point scale, as to their importance (5 = very important, 1 = not important) for their students: first, to the students' success in school and second, to the students' adult life. The data from these two items are summarized in Table 2-7.

Table 2-7
Elementary Teachers:
Relative Importance of Curricular Areas

Area	Importance in School	Importance in Adult Life
Art	2.9*	3.0*
Language Arts	4.9*	4.7*
Mathematics	4.7*	4.4*
Music	2.9*	3.1*
Physical Education	3.6	3.9
Reading	4.9*	4.9*
Science	3.6*	3.4*
Social Studies	3.7*	3.6*

* indicates a significant difference at the 0.05 level among respondent groups

As might be expected Reading, Language Arts, and Mathematics are rated as most important respectively in both school and adult life. However, there is some difference of opinion on the question of just how important these areas are among teachers at various grade levels. The importance of Physical Education is the only one where there was no significant difference in the ratings given by teachers at the four grade levels.

2.4.2 Secondary Teachers

Secondary teachers were asked to choose a number from one to five to indicate how difficult it was to teach mathematics at various levels (1 = difficult, 5 = easy) and also to choose a number to indicate their degree of enjoyment in teaching mathematics at a given

level (1 = do not enjoy, 5 = enjoy). The data gathered from these two items are presented in Table 2-8.

Table 2-8
Secondary Teachers:
Opinions re Teaching at Various Levels

Grade	Degree of Difficulty	Degree of Enjoyment
8	3.8	3.9*
9	4.0	4.1*
10	4.1	4.4*
11	4.3	4.6
12	4.2	4.8*

* indicates a significant difference at the 0.05 level among respondent groups.

There is a high degree of agreement among secondary teachers of mathematics that mathematics is easier to teach at the senior levels than it is at the lower levels. It is also the case that the enjoyment of mathematics teaching increases grade by grade.

The significant differences noted in Table 2-8 require some explanation. The Grade 8 respondents rated their enjoyment of teaching mathematics at the Grade 12 level relatively low, thereby giving rise to the significant difference at the Grade 12 level. The other three significant differences were due primarily to teachers at the higher levels assigning lower ratings to their enjoyment of teaching at the Grade 8, 9, and 10 levels.

It seems somewhat contradictory that teachers of secondary mathematics rate the junior secondary courses as the most difficult to teach and yet it is at this level that there are so many teachers with less than adequate professional or academic training in mathematics. Further attention to these matters would appear to be warranted.

Table 2-9
Secondary Teachers:
Relative Importance of Curricular Areas

Area	Importance in School	Importance in Adult Life
Business Education	3.0	3.8*
English	4.8	4.6
Fine Arts	2.6*	2.8
Mathematics	4.6*	4.2*
Music	2.5*	2.8
Physical Education	3.7*	3.8
Reading	4.9*	4.7
Science	3.9	3.4
Social Studies	3.8	3.5
Vocational Education	3.2*	3.8*

* indicates a significant difference at the 0.05 level among respondent groups.

It is not surprising to find that teachers of secondary mathematics rate their subject as one of the most important both for a student's success in school as well as in adult life. The significant differences that were reported for both ratings of the importance of mathematics were due to the lower ratings assigned by the Grade 12 teachers. Grade 8 and 10 teachers rated mathematics higher in importance than did their Grade 12 colleagues.

2.5 Summary and Interpretation

The information presented in this chapter can be collected and used to sketch the broad outlines of "typical" teachers of mathematics at the elementary and secondary levels. Such an outline must be interpreted with caution and the results should not be applied to an individual teacher.

The "typical" teacher of elementary mathematics has four years of post-secondary education and nine years of teaching experience. One elementary teacher in seven had mathematics as a major area of study in university, one in four has had no mathematics beyond the secondary school level, and one in seven has had no training in methodology of teaching mathematics. There is a good probability that this "typical" teacher has recently attended a conference session or an in-service day dealing with mathematics, but a low probability that he or she belongs to a professional association of mathematics teachers. This teacher considers mathematics to be one of the easiest and most enjoyable subjects to teach, but not to learn as a student.

The "typical" teacher of secondary mathematics has five years of post-secondary education and nine years of teaching experience. There is about a thirty-five percent chance that this teacher did not major in

mathematics. At the Grade 8 level, there is a fifteen percent chance that the teacher has had no post-secondary level mathematics training and a twenty-five percent chance that he or she has never taken a mathematics methods course. There is a fair chance that the teacher belongs to the B.C. Association of Mathematics Teachers and a good possibility that he or she has attended a recent conference or in-service day on mathematics. This teacher considers that mathematics is easiest and most enjoyable to teach at the senior levels, and that it is one of the most important areas of the curriculum.

On the one hand, the general picture that emerges at both the elementary and secondary levels is that most mathematics classes are being taught by experienced teachers with fairly extensive backgrounds in professional training. On the other hand, too many teachers of mathematics have had little or no training either in mathematics or the teaching of mathematics. Moreover, relatively few teachers of mathematics are members of professional associations specializing in the teaching of mathematics.

The situation appears to be particularly acute at the Grade 8 level. In the first year of secondary school, where many of the foundations for future work are laid, students need the guidance and direction of the very best-prepared teachers of mathematics that can be provided. While it may be understandable that a highly qualified teacher of mathematics prefers to teach at the senior levels, this must be balanced against the needs of the students. Schools should ensure that at all levels, but particularly in the secondary grades, mathematics is taught only by persons adequately qualified to do so.

Recommendation 2-4: Secondary schools should ensure that all mathematics classes are taught by only those teachers who are qualified to do so. The situation described in this report concerning the level of qualification of teachers of mathematics at the Grade 8 level would appear to be the one in most urgent need of action.

2.6 Summary of Recommendations

Recommendation 2-1: The Ministry of Education and individual school boards should require that all persons teaching mathematics at the elementary school level should have as a required part of their training the equivalent of at least one course in the teaching of mathematics and one course in mathematics for teachers.

Recommendation 2-2: The Ministry of Education and individual school boards should require that all persons teaching mathematics at the secondary school level have mathematics as one of their major areas of study in their undergraduate training and a course in methods of teaching mathematics. This recommendation is important at all levels, but particularly at the junior secondary ones.

Recommendation 2-3: Rather than expecting each elementary teacher to join several subject-matter specialist associations, schools should apply

for group membership in such associations thereby making many of the benefits of membership available to all teachers on the staff.

Recommendation 2-4: Secondary schools should ensure that all mathematics classes are taught by only those teachers who are qualified to do so. The situation described in this report concerning the level of qualification of teachers of mathematics at the Grade 8 level would appear to be the one in most urgent need of action.

CHAPTER 3

CLASSROOM ORGANIZATION

Teachers were asked to provide information about class size, the amount of time spent preparing and teaching mathematics classes, and certain characteristics of their classroom organizational patterns. Part III of the questionnaire consisted of Items 16 through 22 on the elementary questionnaire and of Items 18 through 26 on the secondary.

3.1 Class Size

The topics of class size and pupil-teacher ratio are of current interest both to educators and to the members of the general public. Teachers know that with large classes it is virtually impossible to give pupils the individual attention they need. Parents and tax payers know that a reduction in the pupil-teacher ratio can translate into an increase in school district budgets.

In Chapter 6 of this volume, teachers' rating of the importance of reduced class size to the success of mathematics instruction is discussed. In the present section, data concerning the actual size of mathematics classes are presented and discussed.

The average size of mathematics classes at the elementary level is 25.0. At the secondary level, the average is 29.4. The average class size for each grade is presented in Figure 3-1.

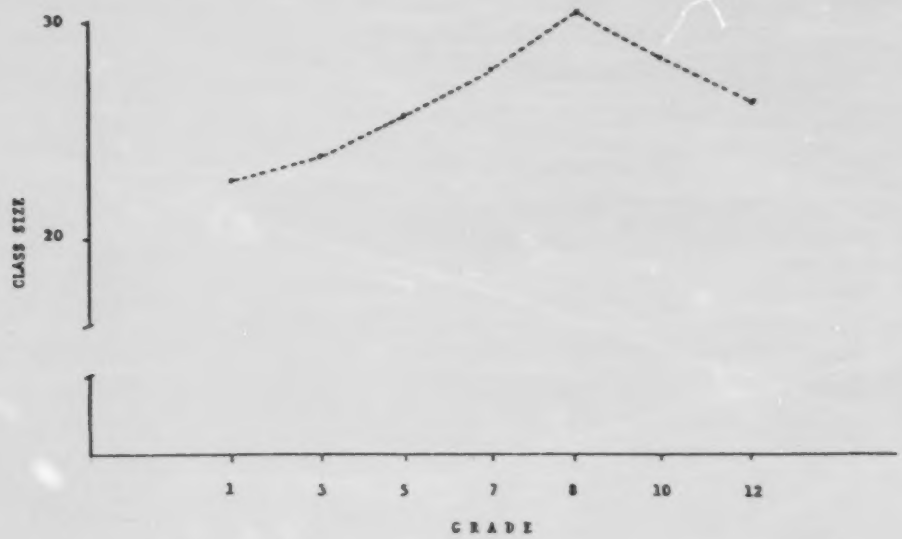

Figure 3-1: Average Class Size for Mathematics

Class size increases steadily from a low of about twenty-three pupils in Grade 1 to a high of nearly thirty-one in Grade 8. The average size then decreases through Grade 10 and 12 to a low of twenty-six. Overall, the average class size at both levels is approximately 26.

3.2 Time Allotments

3.2.1 Elementary Teachers

According to the data, over ninety percent of the elementary teachers teach mathematics five days per week. Almost all the rest do so four days per week. The average length of time spent teaching mathematics at this level is slightly more than fifty-one minutes per day.

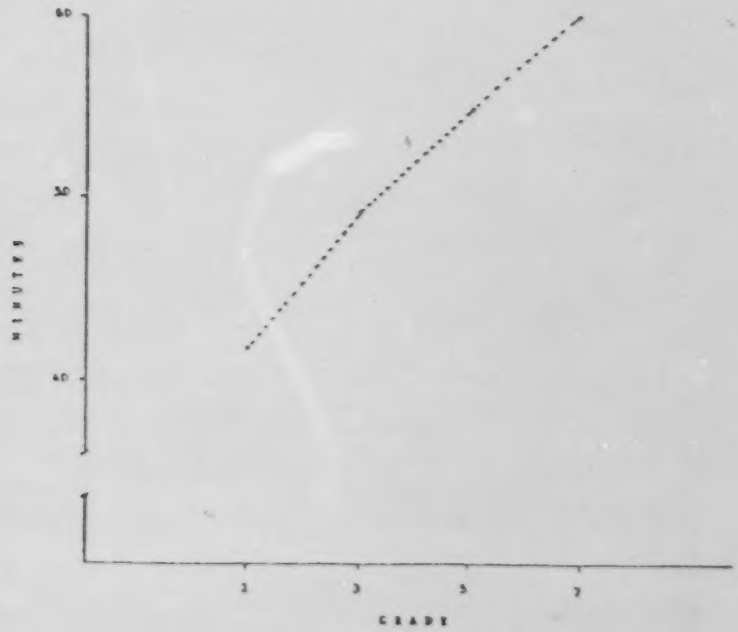

Figure 3-2: Time Spent Teaching Mathematics per Day

The graph in Figure 3-2 should be interpreted with caution. The amount of time spent teaching mathematics each day is not the same as the length of a mathematics period because some of these teachers teach more than one mathematics class. As far as can be told from the data, fewer than ten percent of the respondents do teach more than one mathematics class so the true figures on length of mathematics periods cannot be much different from those reported here.

As the graph shows, the amount of time spent in teaching mathematics each day increases dramatically from Grade 1 to Grade 7. The means at the two upper grade levels may be somewhat inflated because there are likely more teachers at this level teaching more than one mathematics class than at the primary level. Such teachers would only account for a portion of the difference, however. These figures give a fairly good indication that children in the lower grades spend significantly less school time on mathematics than do children in the upper elementary years.

In response to Item 19, teachers of elementary mathematics reported that they spend an average of almost thirty-eight minutes per day in preparing mathematics lessons and in grading. Teachers at the primary levels spend significantly more time at such activities than do intermediate teachers. The data relevant to this question are displayed in Figure 3-3.

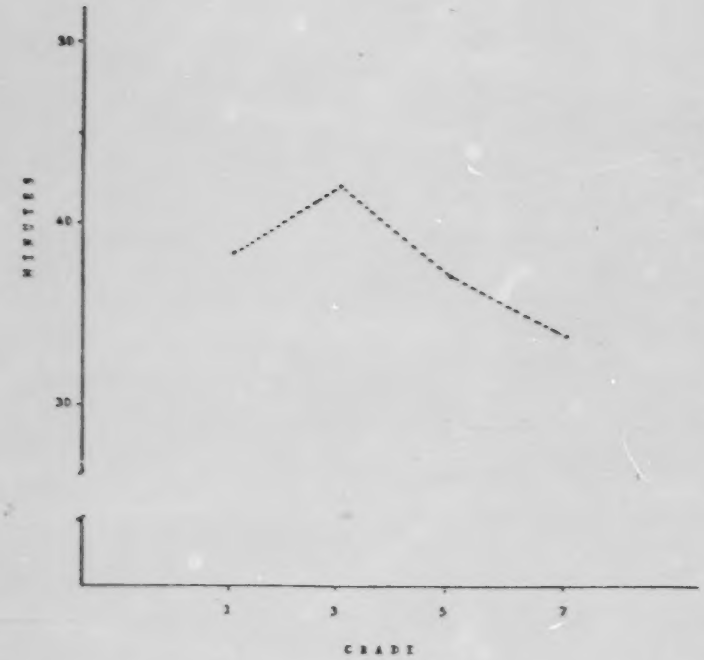

Figure 3-3: Time Spent Daily on Preparation and Marking

3.2.2 Secondary Teachers

Secondary teachers were asked to indicate how much time they spent each day teaching mathematics and how much time they spent each day teaching courses other than mathematics. Their responses are summarized in Table 3-1.

Table 3-1
Secondary Teachers: Daily Teaching Time (minutes)

Grade/Year	Mathematics Courses	Non-Mathematics Courses
8	162.9	96.2
10	186.3	52.3
12	196.2	37.6

The data show again that teachers of mathematics at the senior level are more highly specialized than their junior secondary colleagues. Grade 8 teachers spend only 62.9% of their teaching time in teaching mathematics. The corresponding figures at the 10 and 12 levels are 78.1% and 83.9% respectively.

As in the case of the elementary teachers, almost all of the secondary teachers reported that they teach mathematics five days per week. There were no significant differences among the three grade level groups of teachers in this regard.

Secondary teachers were asked separate questions regarding the amount of time spent on lesson preparation and grading assignments. The teachers indicated that on the average they spend 53 minutes each day on lesson preparation and an additional 38 minutes grading assignments. Responses from all three groups were very similar; there were no significant differences among them.

3.3 Organization for Instruction

Teachers were asked to select from a list of four or five alternatives all of those which described their teaching situation. Since they could pick more than one of the alternatives, some of the columns in Table 3-2 have sums in excess of one hundred percent.

The data show that the vast majority of teachers at all levels teach in self-contained classrooms. This is particularly true at each of the three secondary levels, where more than ninety-five percent of the teachers selected this alternative. The only significant departure occurs at the Grade 7 level where one teacher in five indicates that mathematics is somewhat departmentalized: i.e., one teacher may teach several mathematics classes.

Both team teaching and open area organization are relatively recent educational innovations. The teachers' responses indicate that neither one has made significant inroads at any level, and that both are virtually non-existent at the secondary level.

Table 3-2
Categorization of Teaching Situation (percent)

	Grade/Year						
	1	3	5	7	8	10	12
Self-contained room	86.4	83.8	83.2	77.8	96.1	97.5	98.9
Team Teaching	7.3	5.4	3.8	3.3	0.8	1.8	0.0
Open Area	7.7	8.4	5.5	3.7	0.3	0.7	0.0
Shared Workload*	2.6	5.0	8.6	20.9	N/A	N/A	N/A
Other	3.4	7.0	6.7	6.9	4.7	1.5	0.0

* elementary teachers only (one teacher takes all the mathematics, another takes all the language arts, etc.)

Teachers were also asked to select from among a number of alternatives, the one or ones which best described how their students were organized for mathematics instruction. Since they were permitted to select more than one of the alternatives, the sum of each column in Table 3-3 exceeds one hundred percent.

Table 3-3
Organization for Instruction (percent)

	Grade						
	1	3	5	7	8	10	12
Ability Groups	57.0	56.7	51.3	53.9	32.9	37.3	18.0
Individualized Instruction	27.6	30.7	22.5	20.1	12.5	17.4	18.0
Partially Individualized Instruction	51.1	53.3	50.2	54.5	41.2	40.3	30.3
Total Class Instruction	53.8	52.9	43.7	47.6	66.8	69.4	87.6
Other	5.5	4.2	5.0	3.7	2.3	3.6	4.5

The data in Table 3-3 are somewhat difficult to interpret because of the number of different meanings attached to some of the alternatives described and because of the lack of a decision rule for teachers to use on each alternative to aid in deciding whether or not their particular teaching approach fit a given alternative. For example, no precise definition of the term "individualized instruction" was provided. As a result, teachers who had their students work through a textbook on their own and teachers who had a highly organized system of tests and learning packages administered in a supervised environment would both select "individualized

instruction" as a descriptor of their teaching situation.

These weaknesses notwithstanding, the data in Table 3-3 indicate that many teachers are doing something other than total class instruction with their mathematics classes. The numbers who state that they make use of ability grouping or some form of individualized instruction are large indeed, and indicative of the teachers' awareness of individual differences among their students and their willingness to address this problem. Only at the Grade 12 level where a good deal of self-selection has already taken place does total class instruction become the overwhelming choice of the teachers.

Closely related to the basic classroom organization, are the activities in which students and teacher engage during the mathematics lesson. Teachers were asked to rate a number of such activities on a five point scale according to the number of times each activity was used in their classes (1 = never, 5 = very frequently). The results obtained are summarized separately for elementary and secondary teachers in Tables 3-4 and 3-5. In examining these tables it should be remembered that with groups of the sizes used here, any difference in excess of approximately 0.2 is statistically significant at the 0.05 level. That is, there is only a five percent chance that the differences reported are not real and do not apply to the entire population of teachers at these levels.

Table 3-4
Elementary Teachers: Teaching Activities

	Grade/Year				Overall
	1	3	5	7	Average
Oral Work*	4.4	4.2	3.9	3.8	4.1
Individual Work*	4.3	4.3	4.2	4.2	4.3
Small Group Work*	3.7	3.5	3.3	3.2	3.4
Text Exercises*	3.5	3.9	4.3	4.3	4.0
Math Projects*	3.0	2.9	2.6	2.6	2.8
Teacher Explains*	4.0	4.1	4.2	4.2	4.1
Activity Centres*	3.2	2.9	2.2	2.1	2.6
Drill on Basic Facts*	4.3	4.5	4.1	3.6	4.1

* indicates a significant difference at the 0.05 level among respondent groups.

Table 3-5
Secondary Teachers: Teaching Activities

	Grade/Year 8	10	12	Overall Average
Oral Work	3.6	3.5	3.7	3.6
Individual Work	4.2	4.2	4.0	4.2
Small Group Work	2.7	2.8	2.6	2.7
Text Exercises*	4.1	4.3	4.5	4.2
Math Projects*	2.2	2.3	2.0	2.2
Teacher Explains	4.2	4.2	4.4	4.2
Activity Centres	1.5	1.5	1.4	1.4
Drill on Computation	3.5	3.0	2.1	3.1

* indicates a significant difference at the 0.05 level among respondent groups.

A number of interesting trends are evident in these results. Generally speaking, the frequency of use of text exercises and teacher explanation increases with grade level. For the remaining six activities, the general trend is the opposite: as grade level increases, selection of the alternative decreases. In cases such as the use of activity centres and incidence of small group work there is a dramatic drop between the Grade 7 and 8 levels in their selection of these alternatives.

3.4 Summary

The average size of a mathematics class at the elementary level is 25.0; at the secondary level it is 29.4. The largest average class size occurs at the Grade 8 level, where it is 30.6.

Elementary teachers spend an average of fifty-one minutes per day teaching mathematics, and an additional thirty-eight minutes in lesson preparation and grading of mathematics assignments. Secondary teachers of mathematics, who are more highly specialized and hence have fewer class preparations than elementary teachers, spend an average of 176 minutes per day teaching mathematics, fifty-three minutes in class preparation, and thirty-eight minutes grading.

The self-contained classroom is by far the most common teaching situation at all grade levels. About twenty percent of Grade 7 teachers indicated that there was a degree of departmentalization in their classes: i.e., different teachers for different subjects. Open area classes and team teaching have made some inroads at the primary level, but not at the higher grade levels.

A large proportion of teachers at all levels indicated that some form of ability grouping, partially individualized instruction, and total class

instruction were used in mathematics classes. The use of total class instruction tended to increase with grade level, while the other two decreased.

The most prevalent classroom activities in elementary mathematics classes are individual work, teacher explanation, oral work, drill on basic facts, and work on textbook exercises. At the secondary level they are individual work, textbook exercises, and teacher explanation. The use of activity centres and creative projects for the teaching of mathematics is very limited at both the elementary and secondary levels.

The overall picture presented by these results is that a considerable amount of time is spent in preparing for and teaching mathematics classes, and that the teaching of mathematics is highly traditional in character. Putting together the results of several items shows that the most frequently used teaching techniques are total class instruction and teacher explanation. Among the most commonly used student activities are individual work and textbook exercises. In other words, and particularly at the higher levels, classroom organization for the teaching of mathematics is much the same as it has always been.

CHAPTER 4

USE OF TEXTBOOKS

There is probably no subject in the school curriculum which is more textbook-based than mathematics. For many years, the table of contents of the approved textbook constituted the curriculum for the course. In more recent times, teachers seem to have moved away from dependence upon a single textbook as the determinant of the mathematics curriculum and this movement has been encouraged by the Ministry of Education which has allowed schools and teachers to order multiple textbooks for mathematics instruction.

Part V of the teacher questionnaire consisted of a number of items which were designed to collect information on the ways in which teachers make use of mathematics textbooks, the nature of the textbooks they use, and their degree of satisfaction with the various prescribed texts for mathematics.

4.1 Extent of Use of Textbooks

As the data displayed in Table 4-1 make clear, the use of textbooks by teachers for the teaching of mathematics is virtually universal. The lowest rates of usage occur at the Grade 1 and 8 levels, but even these are greater than ninety percent. At the Grade 1 level it may be that those teachers who do not use a text have developed their own collections of worksheets which they use instead of one of the approved texts. The lower rate at the Grade 8 level is more difficult to explain and may be a cause for some concern in view of the fact that, as was discussed earlier, the academic and professional preparation of teachers of mathematics at this level is lower than at either of the other two secondary levels.

Table 4-1
Extent of Use of Textbooks

Grade Level	Percent Using One or More Mathematics Texts
1	90.5
3	96.8
5	98.8
7	99.4
8	91.4
10	95.9
12	98.9

For the past several years the Ministry of Education has been encouraging teachers of mathematics, particularly at the elementary levels, to utilize more than one textbook. It is hoped that in so doing, teachers will be better able to allow for differences in approach, depth, and rate of learning. The Curriculum Guide for Mathematics stresses the point that

no single text may be considered as the sole instrument for achieving the objectives of the mathematics curriculum.

In order to gauge the degree of acceptance of this philosophy by teachers, respondents who had indicated that they used textbooks were asked whether or not they used a multi-text approach in their teaching of mathematics. The results obtained are presented in Table 4-2.

Table 4-2
Number of Textbooks Used (percent)

	Grade Level						
	1	3	5	7	8	10	12
One basic-text	41.8	20.8	22.9	22.3	41.0	33.9	45.8
Multiple texts, use of one predominant	51.1	55.3	56.9	54.5	47.9	53.2	47.0
Multiple texts, equal use of each	7.1	23.9	20.2	23.2	11.1	12.9	7.2

Very few teachers at either the Grade 1 or Grade 12 level use an equal sharing of multiple texts for the teaching of mathematics. On the contrary, it is in these two grades where teachers say they use one basic textbook more than at any of the other levels. The figures in Table 4-2 indicate that the multi-text approach, ie., equal use of more than one text, does not appear to have gained widespread acceptance at any level, and certainly not at the secondary level.

At least seventy-five percent of the teachers say that they use either one textbook exclusively or multiple texts with one being used predominantly. As a matter of fact, the use of several texts with one predominating is the most popular alternative at each grade level.

On a related item, teachers were asked to indicate whether there should be one prescribed textbook series for mathematics, several prescribed series, or none at all. Their responses are summarized in Table 4-3.

Table 4-3
Teachers' Opinions Regarding the Optimum Number of Prescribed Textbook Series for Mathematics

	Optimum Number of Textbook Series			
	One	Several	None	I don't know
Elementary Teachers	16.8	78.6	2.0	2.5
Secondary Teachers	25.1	69.9	2.8	2.2

Statistically speaking, there were no significant differences among the responses of the three groups of secondary teachers to this item. About one quarter of them were of the opinion that there should be only one prescribed textbook series for mathematics at any level, and most of the remainder considered that there should be several approved series. The general trend was the same among the elementary teachers, although fewer of them maintained that one series was preferable. There was a significant difference in the way in which different grade level groups of elementary teachers responded to this item. More teachers at the Grades 5 and 7 levels preferred the adoption of a single textbook series than did teachers at the Grades 1 and 3 levels.

The final item in this section was designed to determine whether or not teachers felt that they should be provided with an outline of the minimum learning outcomes at each level or grade to guide them in the selection of mathematics textbooks, materials, and activities. Their opinions are summarized in Table 4-4.

Table 4-4
Teachers' Opinions Regarding the Establishment of Minimum Learning Outcomes for Each Grade/Level

	Agree	Disagree	I don't know
Elementary Teachers	94.0	3.6	2.5
Secondary Teachers	92.8	4.0	3.1

There is virtual unanimity among teachers at all levels, elementary and secondary, that an outline of minimum learning outcomes for mathematics at each grade or level should be provided as an aid to teachers, and the 1977 edition of the Curriculum Guide for Mathematics provides a statement of core or essential objectives for each grade. In responding to this item, teachers seem to be requesting such specific guidance in terms of the particular grade or level with which they are concerned as well as in assisting them to decide what are the minimum essentials of the mathematics curriculum for their level.

Recommendation 4-1: The Curriculum Development Branch should provide teachers of mathematics with an outline of the minimum learning outcomes at each level or grade to aid them in the selection of mathematics textbooks, materials, and activities.

4.2 Textbooks for Elementary School Mathematics

4.2.1 Textbook Series Utilized

Teachers of Grades 1, 3, and 5 were asked to name the text

or texts which they used for teaching mathematics. Their responses, reported as percents, are summarized in Figure 4-1. Since many teachers use more than one text, the total percent for each grade exceeds one hundred percent.

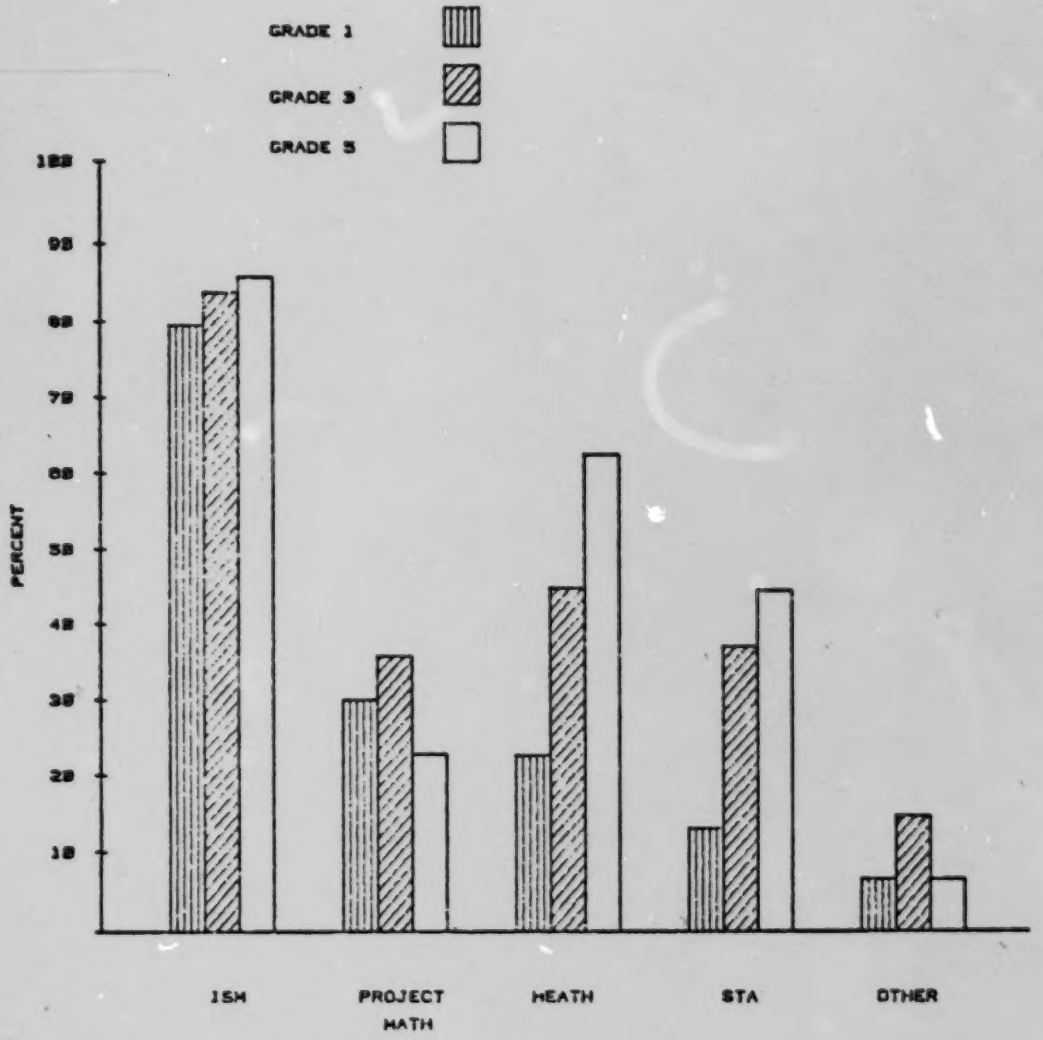

Figure 4-1: Textbooks Used in Grades 1, 3 and 5

The *Investigating School Mathematics* texts are by far the most commonly used at each of these grade levels. Over seventy-five percent of the teachers at each of Grades 1, 3, and 5 use these texts in their mathematics classes.

One surprising piece of information obtained from this item is the extent to which the *Seeing Through Arithmetic* textbooks are still being used. These textbooks were formerly on the list of prescribed series for the teaching of mathematics, but were removed from the list several years ago when the mathematics curriculum was revised. In spite of that, over forty percent of Grade 5 teachers continue to use this textbook.

Teachers may be using the *Seeing Through Arithmetic* texts solely as a source of additional exercises or, perhaps, for alternative teaching approaches to various topics. If, on the other hand, teachers are using these books as basal texts instead of the prescribed series, then there would seem to be a communication problem of considerable magnitude existing between teachers of mathematics at the Grades 1, 3, and 5 levels and those responsible for implementing the spirit and the content of the newly revised mathematics curriculum. An in-depth study of this question seems warranted.

Recommendation 4-2: The Curriculum Development Branch should conduct a province-wide study to discover the reasons for the apparently widespread lack of acceptance by elementary teachers of the newly revised mathematics curriculum and the textbook series prescribed for its implementation.

Grade 7 teachers were also asked to name the textbooks which they used for the teaching of mathematics. Their responses are presented in Table 4-5.

Table 4-5
Grade 7: Textbooks Used

Title	Percent of Use
School Mathematics I (Addison-Wesley)	79.5
Mathematics I (Ginn)	59.9
Essentials of Mathematics I (Ginn)	47.6
Contemporary Mathematics, Book I (Holt, Rinehart)	43.6
Other	3.3

School Mathematics I is the most popular text at the Grade 7 level. *Essentials of Mathematics I* was designed for use by lower ability students which is probably one reason it ranks third in this list. *Mathematics I*, on the other hand, is considered to be the most sophisticated and mathematically rigorous of the three forerunners.

Contemporary Mathematics, Book I is to Grade 7 as *Seeing Through Arithmetic* is to the earlier grades. The text is no longer on the list of prescribed series, and has not been for several years. In spite of this, over forty percent of the Grade 7 teachers continue to make use of it.

Table 4-6
Elementary Teachers: Teachers' Ratings of Textbooks

Rating	Percent
Satisfactory	78.4
Not Satisfactory	20.1
Cannot Say	1.5

The data in Table 4-6 show that almost four out of every five teachers give the textbooks they are using a satisfactory rating overall. This includes teachers at all four elementary grade levels surveyed, regardless of which text they happen to be using for the teaching of mathematics.

4.2.2 Reading in Mathematics Textbooks

The data in Figure 4-2 indicate the amount of textual material in a mathematics textbook which elementary teachers expect their students to read.

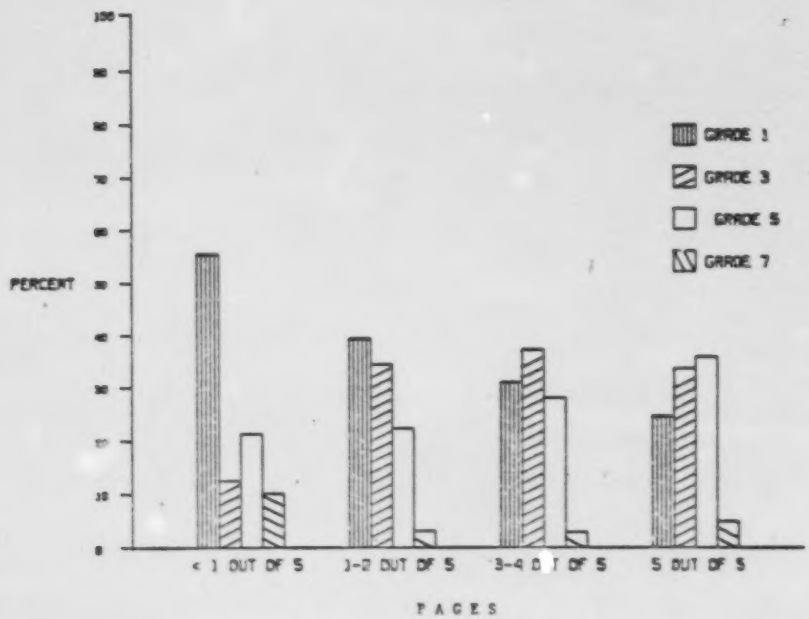

Figure 4-2: Elementary Teachers - Percent of Textbook Read by Students

The Grade 1 teachers' responses to this item were significantly different from those of the other three groups. Substantially more Grade 1 teachers expect their children to read less than one page out of every five pages in their texts than do other elementary teachers. Similarly, at least twice as many Grade 1 teachers say that their students are expected to read every page in their texts than do other elementary teachers. Grade 1 teachers' responses to this item should be interpreted cautiously since mathematics textbooks at this level usually require very little reading. For a typical lesson covering one or two pages in the text, the only reading required may be of the directions for the exercises.

Reading of technical material such as that found in mathematics textbooks requires skills somewhat different from those needed for general reading, skills that must be taught if students are to become adept at reading such material. Mathematics educators at all levels should examine these results and consider means of improving students' reading skills in mathematics.

Overall, the responses to this item indicate that teachers do not expect their students to read a great deal in their mathematics texts. Grade 1 aside, virtually none of the teachers expect their students to read all of the textual material. However, it is encouraging to note a general trend toward an increasing amount of reading of such material as grade level increases so that by the Grade 7 level, seventy percent of teachers expect their students to read between one and four pages out of every five.

Recommendation 4-3: Teachers of intermediate mathematics should place more emphasis upon teaching students how to read mathematics texts with understanding.

Recommendation 4-4: The Curriculum Development Branch, school district curriculum specialists, and publishers of mathematics textbooks should take steps to ensure that mathematics textbooks for the elementary grades are designed to be read by the students, inasmuch as it is possible to do so.

Recommendation 4-4 is not intended to imply that all elementary school students should be able to read a mathematics textbook and master all of its contents on their own. Clearly this is not possible. However, students should be able to comprehend the textual material that is there and, with a teacher's guidance, explanation, and direction, to master the content of the course.

4.2.3 Uses of Pupil's Editions of Textbooks

Teachers were asked to select from a list of ways in which a textbook might be used, those which they employed in their classes. Since they were permitted to select more than one option, the totals in Table 4-7 exceed one hundred percent for each grade.

Table 4-7
Elementary Teachers: In-Class Uses of Textbooks

	Grade Level			
	1	3	5	7
To develop a new concept	23.9	36.9	52.3	53.9
To review concepts developed in class	60.3	66.3	63.3	63.4
To provide exercises for drill and practice	80.3	89.2	89.1	91.5
Other	1.6	1.8	2.9	2.4

By far the most frequent use of the textbook is to provide exercises for drill and practice. In this regard, it is interesting to note that almost twenty percent of Grade 1 teachers do not use a textbook for this purpose. Their number should not include the ten percent who indicated, in response to an earlier item, that they did not use a mathematics textbook, since they were asked to omit all the textbook-related items on the questionnaire. In other words, twenty percent of the Grade 1 teachers who use mathematics textbooks do not use them for drill and practice exercises.

More teachers at every elementary level, but particularly at the primary level, use their textbooks to review concepts which have already been developed in class than to develop new concepts initially. In other words, teachers present the new material themselves and then have pupils turn to their texts in order to reinforce the concepts which they have been discussing.

Over forty-five percent of teachers at all elementary levels do not use their textbooks to introduce new concepts, and over thirty percent do not use them to review concepts developed in class. Teachers who do not use their texts for either of these purposes can only be using them to provide exercises for drill and practice. Persons who are interested in the methodologies of teaching mathematics at this level might wish to pursue this question greater depth.

Recommendation 4-5: Educational researchers and supervisors of instruction should investigate the ways in which mathematics textbooks are used in the elementary schools in an attempt to clarify the interaction between teacher-based discussion and text-book-based discussion.

4.2.4 Attributes of Preferred Textbooks

Elementary teachers were asked to select from a list of five possible attributes of a mathematics textbook the one which best described the kind of textbook they preferred. These results are summarized in Table 4-8.

Table 4-8
Elementary Teachers: Attributes of Preferred Textbooks
(percent)

I prefer a textbook with:	Grade Level 1	3	5	7
Great emphasis on skills/ drill	22.2	16.1	13.5	11.7
Greater emphasis on skills/ drill than concepts/ principles	25.6	30.4	32.2	28.9
Equal emphasis on skills/ drill and concepts/ principles	45.3	48.8	49.4	53.9
Greater emphasis on concepts/principles than skills/drill	4.3	3.5	3.9	4.8
Great emphasis on concepts/principles	2.5	1.3	1.0	0.7

There are some differences in the ways in which teachers from different grade levels responded to this item. For example, although the percentages are low, it is more common for primary teachers to prefer an emphasis on concepts/principles than it is for intermediate teachers. This preference is probably a reflection of the fact that the curriculum calls for such an emphasis at the primary level where relatively few of the major computational skills are mastered, but where many basic and important concepts are introduced.

At every grade level, over ninety percent of the teachers say they prefer texts with at most an equal balance between skills/drill and concepts/principles. In fact, almost fifty percent of all the respondents selected the third choice: equal emphasis on both.

On a related item, teachers were asked to rate the importance of each of a number of purposes for a mathematics textbook. The ratings ranged from a low of 1, Not Important, to 5, Very Important. The

results obtained are displayed in Table 4-9.

Table 4-9
Elementary Teachers: Purposes of Mathematics Textbooks

A Textbook should:		Grade Level 1	3	5	7	Overall
...develop concepts	*	3.85	4.02	4.16	4.20	4.06
...provide drill and practice		4.67	4.73	4.71	4.75	4.71
...provide enrichment	*	4.04	4.18	4.08	3.95	4.07
...motivate the student	*	4.12	4.05	4.07	3.77	4.00
...provide remedial material	*	3.55	3.85	3.81	3.68	3.73

*indicates a significant difference at the 0.05 level among respondent groups

There are significant differences among the four groups of respondents on all but one of the five purposes listed. All teachers agree that a mathematics textbook should provide drill and practice material. There is a fairly pronounced tendency for teachers at the upper grade levels to expect the textbook to provide developmental material for introduction of new concepts, and an equally pronounced tendency for them to expect less in the way of motivation from the textbook. All four groups rate the provision of remedial material as the least important of these five purposes.

4.2.5 Preferred Characteristics of Teacher's Editions

All of the contemporary mathematics textbooks are accompanied by specially annotated editions which are designed to assist teachers in lesson preparation and in teaching. Respondents were asked to rate each of a number of characteristics of such teacher's editions on a scale from 1, Not Important, to 5, Very Important. Their ratings are summarized in Table 4-10.

Table 4-10
Elementary Teachers: Importance of Certain Characteristics of Teachers' Editions

The teacher's edition should provide		Grade Level 1	3	5	7	Overall
...lesson objectives	*	4.40	4.33	4.18	4.08	4.25
...suggested discussion	*	3.72	3.77	3.68	3.45	3.65
...lesson development	*	4.08	4.10	3.96	3.84	4.00
...exercise answers at the end	*	2.45	3.38	3.56	3.68	3.29
...enrichment materials	*	4.38	4.36	4.27	4.14	4.28
...remediation materials	*	4.25	4.27	4.18	4.04	4.18
...follow-up activities	*	4.40	4.35	4.14	4.00	4.22
...suggested resources	*	3.71	3.55	3.34	3.33	3.48
...achievement tests	*	3.30	3.83	3.96	3.91	3.76
...diagnostic tests	*	3.69	4.05	4.20	4.15	4.03
...suggested teaching aids	*	4.00	3.91	3.70	3.57	3.79
...time allotments	*	2.61	2.73	2.86	2.72	2.74
...overprinted answers	*	2.73	3.67	4.01	3.86	3.59

* indicates a significant difference at the 0.05 level among respondent groups

As is noted in the table, there was a significant difference in the way the four groups responded to each of the factors. On five of the thirteen, the importance of the factor decreases steadily with an increase in grade level. In only one case, exercise answers at the end, does the reverse trend hold true.

In every case but the one just mentioned the Grade 7 teachers rank the factors lower than do the Grade 5 teachers. As will be seen later, it is also true at the secondary level that the senior secondary teachers tend to rate the importance of teachers' editions less highly than do their junior secondary colleagues.

These data indicate that teachers want the features which are commonly found in teachers' editions of mathematics textbooks. Of the fifty-two ratings shown in Table 4-10, only five are less than 3.0, the mid-point of the scale, and the lowest rating was 2.45.

4.2.6 Ratings of Textbooks: Grades 1, 3, and 5

Teachers of Grades 1, 3, and 5 were asked to rate three approved textbook series on each of four factors: reading level; stress on whole number computation; stress on problem solving; and stress on metric measurement. The graphs in Figures 4-3 through 4-5 that are used to summarize the data are based on percents which have been adjusted so as to include the opinions of only those teachers who were sufficiently familiar with a series to rate it on a given

factor. In some of these factors, as many as one-half of the respondents stated that they did not have enough information to make a judgment.

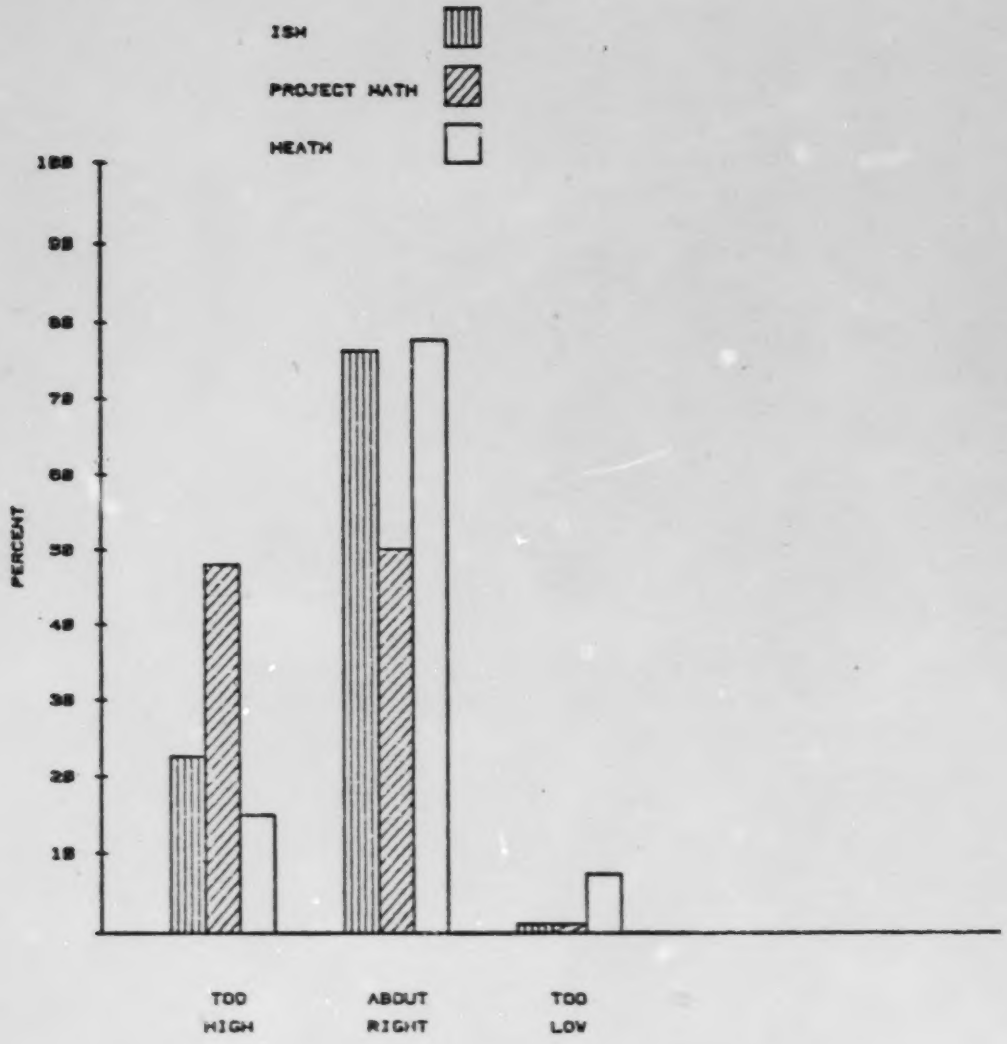

Figure 4-3: Teachers' Ratings of Reading Levels of Textbooks

In Figure 4-3, and the two subsequent graphs, "ISM" denotes *Investigating School Mathematics*, "Project Math" denotes *Project Mathematics*, and "Heath" denotes *Heath Elementary Mathematics*. These abbreviated forms will also be used in the text discussing the data.

Both ISM and Heath seem to be satisfactory to the large majority of teachers insofar as their reading levels are concerned. On the other hand, almost half of the teachers who are familiar with Project Math feel that the reading level in that series is too high. Very few teachers indicated that any of the series had too low a reading level.

Project Math was seen by teachers as placing too little emphasis on computation with whole numbers. Over 55% of the respondents gave the series a low rating on this factor. Almost none of the teachers indicated that any of the series emphasized whole number computation too much.

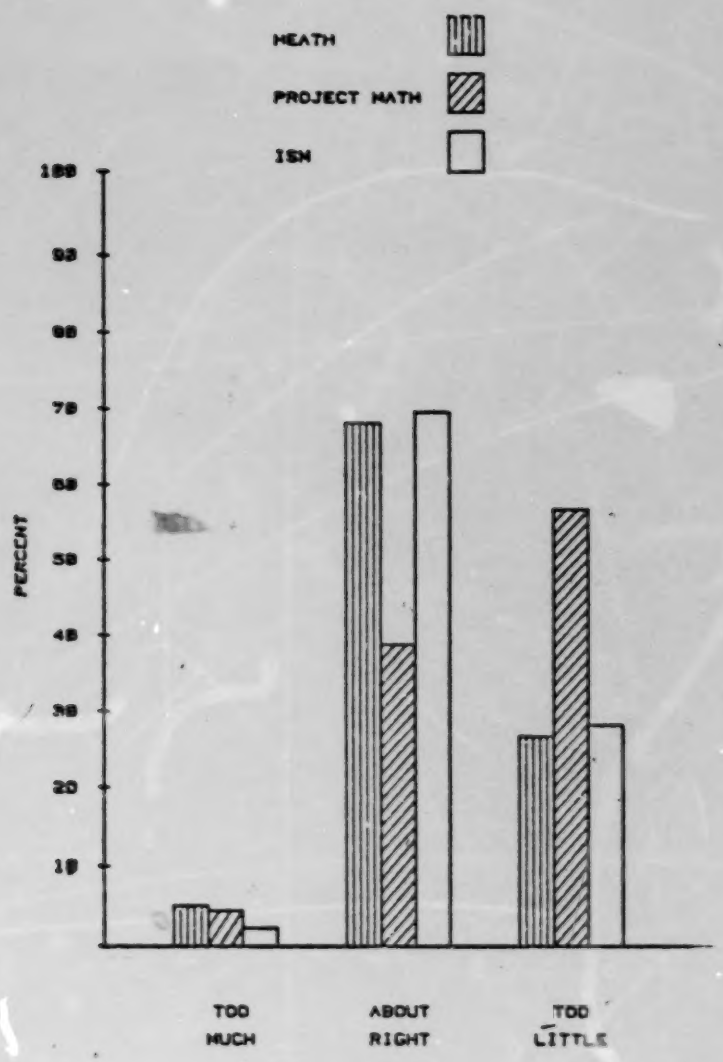

Figure 4-4: Teachers' Ratings of Emphasis on Computation in Textbooks

Problem solving is one of the major strands in the mathematics curriculum, and teachers were asked to rate the three series with respect to the extent of their treatment of this topic. As the graph in Figure 4-5 shows, a substantial proportion of respondents think that all three series place too little emphasis on problem solving. On the other hand, almost fifteen percent see Project Math as placing too much stress on it.

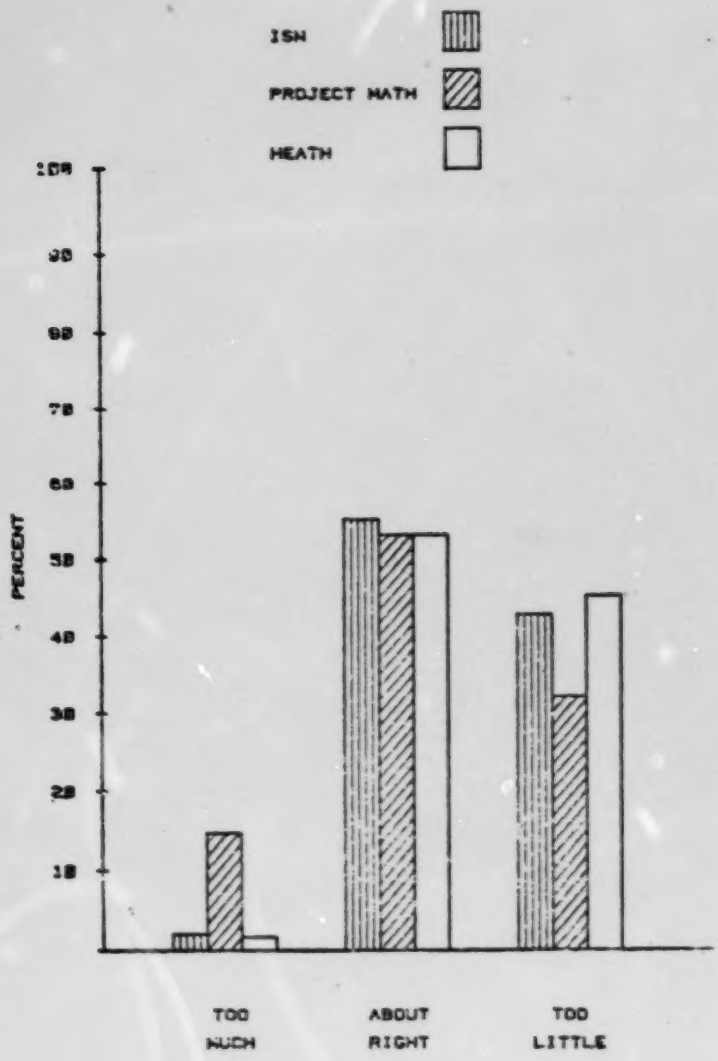

Figure 4-5: Teachers' Ratings of Emphasis on Problem-Solving in Textbooks

Finally, Grade 1, 3, and 5 teachers were asked to rate the three textbook series according to their stress on metric measurement. The results for all three series were virtually the same. Between sixty and sixty-five percent of the respondents expressed the opinion that all three series had the correct emphasis on metric measurement, while between thirty and thirty-five percent said there was too little such stress in all three series. Almost none of the teachers indicated that any of the series over-emphasized the topic of metric measurement.

4.2.7 Ratings of Textbooks: Grade 7

Grade 7 teachers responded to the same four questions as the Grade 1, 3, and 5 teachers with respect to their textbooks: *School Mathematics I* (School Math), *Mathematics I* (Math I), and *Essentials of Mathematics I* (Essentials). The percentages reported in this section have been adjusted to reflect only the opinions of those teachers who felt qualified to rate a particular textbook on a given factor.

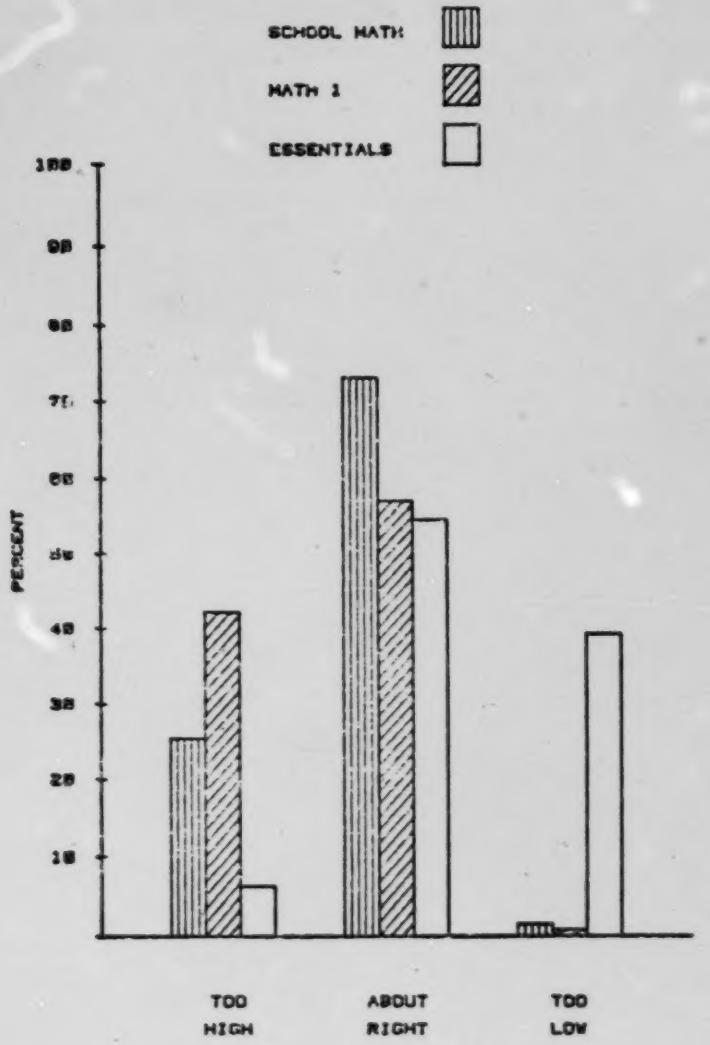

Figure 4-6: Grade 7 Teachers' Ratings of Reading Levels of Textbooks

The results displayed in Figure 4-6 indicate that School Math was rated as having just about the correct reading level by three-quarters of the respondents, and hardly anyone rated either it or Math I as having too low a reading level. Essentials, on the other hand, was judged to have too low a reading level by almost forty percent of those responding. It should be noted that this text was written for low ability students.

On the ratings of the emphasis on computation with whole numbers, in the three texts between thirty-three and forty-one percent of the teachers felt that there was too little emphasis in any of the three textbooks. This appears to be a relatively serious criticism of these books since computational skills with whole numbers are so important to the elementary curriculum.

The Essentials text was seen to be the weakest of the three in the extent of its treatment of problem solving. As the graph in Figure 4-7 indicates, however, the other two texts were not rated especially highly on this trait either.

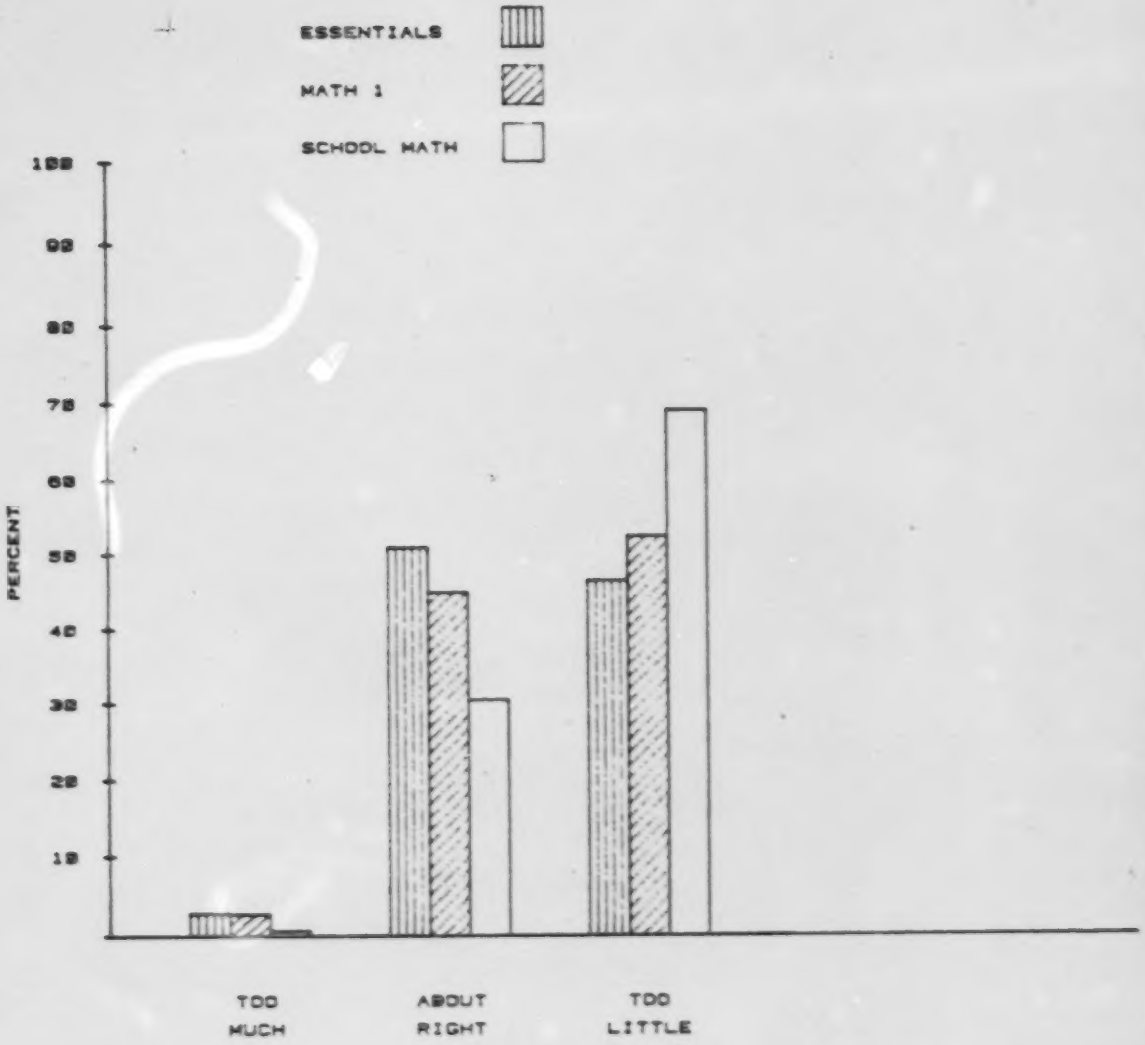

Figure 4-7: Grade 7 Teachers' Ratings
of Emphasis on Problem Solving in Textbooks

As with the Grade 1, [illegible] and 5 teachers, the Grade 7 teachers seemed to feel that all three texts were about the same with respect to their treatment of the metric system. No text was rated as giving too much emphasis to the topic, but a large proportion of the teachers felt that all three devoted too little space to the treatment of this topic.

4.3 Textbooks for Secondary School Mathematics

4.3.1 Reading in Mathematics Textbooks

All three groups of secondary teachers of mathematics were in substantial agreement concerning the amount of reading they expect their students to do in their mathematics texts. For that reason, only the overall averages are reported in Table 4-11.

Table 4-11
Secondary Teachers: Proportion of Textbook Read by Students

Proportion	Percent
Less than 1 page out of 5	40.5
1 - 2 pages out of 5	34.3
3 - 4 pages out of 5	20.5
5 pages out of 5	4.8

Almost seventy-five percent of these teachers indicate that their students are expected to read at most two pages out of every five in their textbooks, a rate almost ten percent higher than for the elementary teachers.

Reading of technical material such as that found in mathematics textbooks requires skills which are somewhat different from those needed for general reading, skills which must be learned and taught. Teachers of mathematics at all levels should examine these results and consider means of improving students' skills in the reading of mathematics.

Recommendation 4-6: Teachers of secondary mathematics should place more emphasis upon teaching students how to read mathematics texts with understanding.

Recommendation 4-7: The Curriculum Development Branch, school district curriculum specialists, and publishers of mathematics textbooks should take steps to ensure that mathematics textbooks for the secondary grades are designed to be read by the students inasmuch as it is possible to do so.

Recommendation 4-7 is not intended to imply that all secondary students should be able to master the contents of a mathematics text on their own. This is probably not possible, and it is certainly not desirable from a methodological viewpoint. However, students should be able to comprehend the material that is in the text which, in turn, means that this material should be written for the student and not solely for the teacher.

4.3.2 Uses of Pupils' Edition of Textbooks

Secondary teachers were asked to select from a list of ways in which a textbook might be used in their classes. Since they were permitted to select more than one option, the totals of each column in Table 4-12 exceed one hundred percent.

Table 4-12
Secondary Teachers: In-Class Uses of Textbooks

	Grade Level		
	8	10	12
To develop a new concept	38.3	34.6	25.0
To review concepts developed in class	45.2	53.5	48.8
To provide exercises for drill and practice	90.4	91.2	94.3
Other	2.6	0.4	1.1

Over ninety percent of the teachers of secondary mathematics at each of the three levels sampled indicated that they used the pupils' text as a source of exercises for drill and practice. These percentages are not at all surprising; indeed it is interesting to speculate as to why the other six to ten percent of the teachers do not use their textbooks for this purpose.

Many teachers do not use their textbooks either to develop new concepts or to review concepts developed in class. In both cases, the percentages reported for the secondary teachers are considerably smaller on the average than the comparable percentages for elementary teachers. These data seem to indicate that many teachers of secondary mathematics use the textbook only as a source of exercises and not as aid for the development of new concepts or the review of concepts previously introduced.

Recommendation 4-8: Educational researchers and supervisors of instruction should investigate the ways in which mathematics textbooks are used for the teaching of secondary mathematics in an attempt to clarify the relationship between teacher-based discussion and textbook-based discussion.

4.3.3 Attributes of Preferred Textbooks

Secondary teachers were asked to select from a list of five possible attributes of a mathematics textbook the one which best

described the kind of textbook they preferred. These results are summarized in Table 4-13.

Table 4-13
Secondary Teachers: Attributes of Preferred Textbooks

I prefer a textbook with:	Percent
Great emphasis on skills/drill	15.6
Greater emphasis on skills/drill than concepts/principles	30.7
Equal emphasis on skills/drill and concepts/principles	48.9
Greater emphasis on concepts/principles than skills/drill	4.2
Great emphasis on concepts/principles	0.6

Because there were no significant differences among the grade level groups' responses, only the overall averages are presented in Table 4-13. The results show a distinct preference among teachers for textbooks which place greater emphasis upon the skills of mathematics than those which emphasize the concepts and principles. Over ninety-five percent of these teachers state that they prefer a mathematics text which has at most an equal balance between emphasis upon skills and concepts/principles.

The teachers were then asked to rate the importance of each of a number of purposes which a mathematics text might serve. The ratings ranged from a low of 1, meaning the purpose was not important, to a high of 5, which meant that the purpose was very important. The average rating for each of the purposes listed in the item is shown in Table 4-14.

Table 4-14
Secondary Teachers: Purposes of Mathematics Textbooks

A Textbook should:	Average Rating
...develop concepts	4.01
...reinforce skills	4.52
...provide drill and practice	4.72
...provide enrichment material	* 3.86
...motivate the student	3.90
...provide remedial material	3.64

* indicates a significant difference at the 0.05 level among respondent groups.

There was a significant difference among the three groups on their responses to only one of the purposes, namely the provision of enrichment material. In this case the Grade 8 teachers felt that this was a less important purpose than did either the Grade 10 or the Grade 12 teachers.

Each of the purposes was rated quite highly; the lowest rating was 3.64 for the provision of remedial material. The ratings of the reinforcing skills factor and the providing drill and practice factor are extremely high. The high rating given to the development of concepts would appear to conflict with the teachers' earlier downgrading of their use of textbooks for this purpose.

4.3.4 Preferred Characteristics of Teacher's Editions

All of the contemporary textbooks for secondary school mathematics are accompanied by specially annotated editions for teachers which are designed to assist them in lesson preparation and teaching. Respondents were asked to rate each of a number of characteristics of such teacher's editions on a scale ranging from 1, Not Important, to 5, Very Important. Their ratings are summarized in Table 4-15.

Table 4-15
Secondary Teachers: Importance of Certain Characteristics of Teacher's Editions

The teacher's edition should provide:		Grade Level 8	10	12
...lesson objectives	*	3.96	3.78	3.54
...suggested discussion	*	3.56	3.47	3.22
...lesson development	*	3.60	3.48	3.24
...exercise answers at the end	*	3.78	3.88	4.20
...enrichment materials	*	4.11	4.04	4.00
...remediation materials	*	4.06	3.85	3.74
...follow-up activities	*	3.91	3.78	3.60
...suggested resources	*	3.45	3.49	3.17
...achievement tests	*	3.90	3.77	3.60
...diagnostic tests	*	4.06	3.96	3.60
...suggested teaching aids	*	3.57	3.44	3.02
...time allotments	*	3.06	3.01	3.12
...overprinted answers	*	3.80	3.48	3.24

* indicates a significant difference at the 0.05 level among respondent groups.

There is a significant difference among the three grade level groups of teachers of secondary mathematics in their responses to each of characteristics listed. In ten of the thirteen cases, there is a definite trend for the rating to decrease as grade level increases. In only one case, the characteristics of having a set of answers at the end of the text, is this situation reversed.

In most cases, the ratings given these characteristics by the secondary teachers are lower than those given by the elementary teachers. This indicates that secondary teachers as a group are not as enthusiastic about certain features of teacher's editions of mathematics textbooks as their elementary colleagues are. On the other hand, none of the ratings in the table is less than 3.0, so it would not be correct to conclude that secondary teachers do not want or make use of the teacher's editions.

4.3.5 Ratings of Textbooks: Grade 8

Before being asked to rate the various prescribed textbooks for Grade 8 mathematics, the Grade 8 teachers were asked to name the text or texts which they were using in their mathematics classes. Since many teachers use more than one text, the total percentage in Table 4-16 exceeds one hundred percent.

Table 4-16
Grade 8 Teachers: Textbooks Used

Textbook	Percent
School Mathematics II	53.8
Mathematics II	53.5
Essentials of Mathematics II	32.4
Fundamental Concepts of Elementary Mathematics	0.2
Other	8.1

No one text appears to have the predominant position in Grade 8. *School Mathematics II* and *Mathematics II* have virtually equal shares of the market. The third major text, *Essentials of Mathematics II*, is aimed at students of lower ability and this fact probably accounts for its having a smaller share of the Grade 8 market.

Grade 8 teachers were the most dissatisfied among the secondary teachers with the textbooks that they were using. Only 61.4% of them said they found their texts to be satisfactory, and 36.1% found them to be unsatisfactory, generally speaking. This rate of dissatisfaction is substantially higher than the comparable rate at any of the other levels sampled, elementary or secondary.

A more precise idea of what teachers at this level find unsatisfactory about their textbooks may be obtained by an examination of their responses to four items in which they were asked to rate their textbooks on each of four factors. The four factors were reading level, stress on computation, stress on problem solving, and stress on enrichment. In the discussion of the texts which follows, the data are expressed in percents which have been adjusted so as to include the opinions of only those teachers who were sufficiently familiar with a given textbook to rate it for a particular factor. On some of these factors, as many as thirty percent of the respondents stated that they did not have sufficient information upon which to base a valid judgment.

In the graph shown in Figure 4-8 which describes teachers' ratings of the reading levels of the Grade 8 mathematics textbooks, School Math denotes the *School Mathematics II* textbook, Math II the *Mathematics II* text, and Essentials the *Essentials of Mathematics II* text. These abbreviated forms will also be used in the text which contains the discussions of these ratings.

As indicated in Figure 4-8, at least a majority of the respondents see each of the texts as having just about the right reading level for the grade level. However, slightly more than one-third of the teachers feel that the reading level in Essentials is too low. The fact that the reading level in this text is too low, according to some teachers, is undoubtedly due to its having been written for lower ability students.

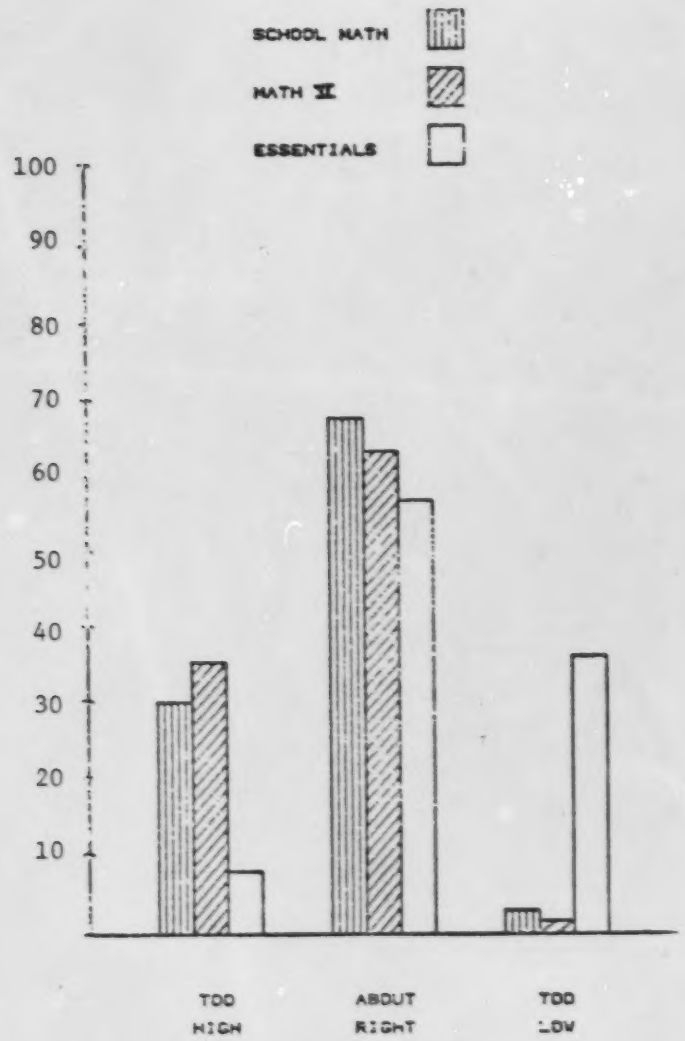

Figure 4-8: Grade 8 Teachers' Ratings of Reading Levels of Textbooks

There was a considerable degree of agreement among the respondents in their ratings of the textbooks' emphases on computation and problem solving. No text was seen by more than five percent of the teachers as placing too much stress on either of these areas, and over forty percent felt that all three textbooks placed too little emphasis on both. These

ratings constitute a serious criticism of the three prescribed Grade 8 texts, and something should be done to improve the situation.

Recommendation 4-9: Persons responsible for the approval and adoption of mathematics textbooks at the Grade 8 level should take under advisement the concerns expressed by Grade 8 teachers concerning the treatment of computational skills and problem solving in the textbooks.

Slightly more than fifty percent of the teachers felt that Essentials placed too little emphasis upon enrichment topics. Again, it should be noted that this text was written for lower ability students so it is not overly surprising that it contains little in the way of enrichment topics. Both School Math and Math II were judged by seventy percent of the teachers as having about the right amount of enrichment.

4.3.6 Ratings of Textbooks: Grade 10

There is a fairly large number of textbooks which have been prescribed for use in Grade 10 mathematics. Teachers were asked to indicate which texts they used with their mathematics classes; these results are summarized in Table 4-17. Since a teacher may be using more than one text, the total in the table exceeds one hundred percent.

Table 4-17
Grade 10 Teachers: Textbooks Used

Textbook	Percent
Mathematics for a Modern World, 2	69.5
Geometry	19.6
Mathematics: A Modern Approach	21.1
Trouble-Shooting Mathematics Skills	20.0
Essentials of Mathematics III	7.6
Modern Algebra, Book 1	46.2
Mathematical Pursuits Two	8.0
Business and Consumer Mathematics	34.5
Career Mathematics, Industry and Trade	21.1
Other	8.0

One text, *Mathematics for a Modern World*, is used by almost seventy percent of the Grade 10 teachers of mathematics. The next most commonly used book was selected by less than fifty percent of the teachers. Two of the texts, *Essentials of Mathematics* and *Mathematical Pursuits Two*, are used by less than ten percent of the teachers.

Grade 10 teachers are more satisfied with their textbooks than are the Grade 8 teachers. Slightly more than seventy percent of the Grade 10 teachers indicated that, in general, they were satisfied with the books. Some twenty-five percent indicated that they found the text or texts they were using to be unsatisfactory.

A clearer picture of what the teachers mean by their ratings of the textbooks as satisfactory or unsatisfactory may be obtained from an examination of their responses to four items in which the teachers were asked to rate the textbooks on each of four factors. The four factors were reading level, emphasis on computation, emphasis on problem solving, and emphasis on enrichment topics. In the discussion of the teachers' judgments on these four factors, the data are expressed as percents which have been adjusted to reflect the opinions of only those teachers who were sufficiently familiar with a given textbook to rate it on a particular factor. On some of these factors at the Grade 10 level, a large proportion of the respondents felt unqualified to express an opinion. For example, in the case of the *Mathematical Pursuits Two* text, almost seventy percent of the teachers did not give a rating for the emphasis on problem solving in that text.

Table 4-18 summarizes the teachers' ratings of the reading levels of the nine prescribed textbooks.

Table 4-18
Grade 10 Teachers' Ratings
of the Reading Levels of Textbooks

Text	Too High	About Right	Too Low
Mathematics for a Modern World, 2	3.4	89.9	6.7
Geometry	62.8	37.2	0.0
Mathematics: A Modern Approach	6.9	78.4	14.7
Trouble-Shooting Mathematics Skills	1.6	62.1	36.3
Essentials of Mathematics III	1.1	44.9	53.9
Modern Algebra, Book I	34.2	65.8	0.0
Mathematical Pursuits Two	45.3	45.3	9.3
Business and Consumer Mathematics	22.3	71.5	6.2
Career Mathematics, Industry and Trade	10.2	81.8	8.0

Four of the nine texts were judged by more than twenty percent of the teachers as having too high a reading level for their students; one text, *Geometry*, was considered to have too high a reading level by more than sixty percent of the respondents.

On the other hand, only two texts were judged to have too low a reading level by more than twenty percent of the teachers. Both of these are texts designed to be used with lower ability students, and this undoubtedly accounts for their low reading levels.

Almost ninety percent of the teachers rated *Mathematics for a Modern World* and *Consumer Mathematics* as having just about the correct reading level for their students. The former is also the text used by more teachers than any other prescribed text.

The ratings of the textbooks with respect to their stress on the topic of computational skills are summarized in Table 4-19.

Table 4-19
Grade 10 Teachers' Ratings
of Stress on Computation in Texts

Textbook	Too Much	About Right	Too Little
Mathematics for a Modern World, 2	0.5	58.3	41.2
Geometry	5.9	51.5	42.6
Mathematics: A Modern Approach	8.5	70.9	20.5
Trouble-Shooting Mathematics Skills	10.9	82.2	7.0
Essentials of Mathematics III	2.4	56.1	41.5
Modern Algebra, Book 1	1.3	79.0	19.7
Mathematical Pursuits Two	8.3	51.7	40.0
Business and Consumer Mathematics	10.0	78.5	11.5
Career Mathematics, Industry and Trade	6.0	77.4	16.7

Four of the textbooks, including *Mathematics for a Modern World*, the most popular text, were judged by more than forty percent of the teachers to devote too little emphasis to the topic of computational skills. This would appear to be a very serious criticism of these texts. *Modern Algebra*, on the other hand, received a positive rating on this factor from almost eighty percent of those who responded. Several other textbooks also received high ratings on this factor, and all of them are textbooks designed for use primarily with students of low ability in mathematics.

The third factor concerning the mathematics textbooks which the teachers were asked to rate was the degree of emphasis placed upon

problem solving. These results are displayed in Table 4-20.

Table 4-20
Grade 10 Teachers' Ratings
of Emphasis on Problem Solving in Texts

Textbook	Too Much	About Right	Too Little
Mathematics for a Modern World, 2	0.5	57.3	42.2
Geometry	19.8	63.2	17.0
Mathematics: A Modern Approach	0.9	51.8	47.3
Trouble-Shooting Mathematics Skills	0.0	51.3	48.7
Essentials of Mathematics III	0.0	41.6	58.4
Modern Algebra, Book 1	7.1	84.4	8.4
Mathematical Pursuits Two	12.5	62.5	25.0
Business and Consumer Mathematics	5.0	78.3	16.7
Career Mathematics, Industry and Trade	3.8	83.5	12.7

According to the teachers, the *Modern Algebra* text is clearly superior to all the others insofar as the extent of its treatment of problem solving is concerned. *Mathematics for a Modern World* was rated as having too little emphasis on problem solving by over forty percent of those responding to this item. No text was rated as over-emphasizing problem solving by more than twenty percent of the teachers although *Geometry* was within 0.2% of this range.

The fourth and final factor rated was the texts' stress on enrichment topics. The teachers' ratings of this factor are presented in Table 4-21.

Four textbooks were judged by more than fifty percent of the teachers to contain too little in the way of stress on enrichment topics. Three of the four are low achiever texts, and the fourth is the most widely used textbook, *Mathematics for a Modern World*. *Modern Algebra* was given the highest percent rating as being about right in its emphasis on enrichment. At the same time, *Modern Algebra* also obtained the lowest percent rating of all the books as far as having too little emphasis on enrichment is concerned.

Table 4-21
Grade 10 Teachers' Ratings
of Emphasis on Enrichment in Texts

Textbook	Too Much	About Right	Too Little
Mathematics for a Modern World, 2	0.5	40.6	58.9
Geometry	15.2	65.7	19.0
Mathematics: A Modern Approach	0.0	28.6	71.4
Trouble-Shooting Mathematics Skills	0.0	30.8	69.2
Essentials of Mathematics III	1.4	38.6	60.0
Modern Algebra, Book 1	4.6	77.8	17.6
Mathematical Pursuits Two	13.8	63.8	22.4
Business and Consumer Mathematics	3.4	60.5	36.1
Career Mathematics, Industry and Trade	0.0	67.9	32.1

Examination of the data presented in Tables 4-17 through 4-21 raises some questions about how and why textbooks are adopted. Although *Mathematics for a Modern World, Book 2* is far and away the most widely used text at the Grade 10 level, it ranked first only for reading level. Teachers rated it in sixth place out of nine for being about right on computation, sixth for being about right on problem solving, and sixth for being about right in its emphasis on enrichment. *Modern Algebra, Book 1*, on the other hand was rated first on two of these three factors and second on the remaining one.

4.3.7 Ratings of Textbooks: Grade 12

Grade 12 teachers were asked to indicate which textbooks, from a list of five, they used with their mathematics classes. Their selections, expressed in percents, are shown in Table 4-22. Since a teacher may be using more than one text, the total in the table exceeds one hundred percent.

Modern Algebra and Trigonometry II is by far the most commonly used text at this level. Almost ninety percent of the teachers use it. *Mathematics for a Modern World 1112*, which is a later volume in the same series as the most popular Grade 10 text, is not widely used, although this may be due in part to its being one of the newest textbooks listed. *Introduction to Calculus* and *Using Advanced Algebra* were rated second and third in usage, respectively.

Table 4-22
Grade 12 Teachers: Textbooks Used

Textbook	Percent
Modern Algebra and Trigonometry II	87.6
Introduction to Calculus	66.3
Mathematics for a Modern World 1112	13.5
Using Advanced Algebra	51.7
Pre-Calculus Mathematics	21.3
Other	1.1

Grade 12 teachers were extremely satisfied with their mathematics textbooks. Ninety-four percent of them chose the satisfactory rating, and only six percent declared themselves dissatisfied. This pattern of response was significantly different from that found at either of the two other secondary levels or, for that matter, at any of the elementary school grade levels.

A more detailed description of these teachers' likes and dislikes about these textbooks may be obtained by examining their responses to four items in which they were asked to rate the texts on each of four factors. The four factors were reading level, emphasis on computation, emphasis on problem solving, and emphasis on enrichment topics. In the discussion of the teachers' judgments on these four factors, the data are expressed as percents which have been adjusted to reflect the opinions of only those teachers who were sufficiently familiar with a given textbook to rate it on a particular factor. On some of these factors for certain textbooks at the Grade 12 level, a large proportion of the respondents considered themselves unqualified to express an opinion. For example, in the case of *Mathematics for a Modern World 1112*, over sixty percent of the Grade 12 teachers did not rate the text on the factors of stress on computation and stress on problem solving.

In Table 4-23 a summary of the teachers' ratings of the reading levels in the texts is presented.

Using Advanced Algebra was given the most favorable rating as far as reading level is concerned. Over ninety percent rated it as being about right. The most popular text, *Modern Algebra and Trigonometry II*, and *Pre-Calculus Mathematics* were both seen by over sixty percent of the raters as having too high a reading level and this may be part of the reason that Grade 12 teachers do not have their students read more in their mathematics texts (see Section 4.3.1). *Mathematics for a Modern World 1112* obtained the poorest rating on this factor with over forty percent saying that its reading level was too low.

Table 4-23
Grade 12 Teachers' Ratings
of the Reading Levels of Textbooks

Textbook	Too High	About Right	Too Low
Modern Algebra and Trigonometry II	61.2	38.8	0.0
Introduction to Calculus	20.9	70.1	9.0
Mathematics for a Modern World 1112	0.0	59.0	41.0
Using Advanced Algebra	1.6	93.4	4.9
Pre-Calculus Mathematics	62.8	37.2	0.0

The second factor rated was the amount of stress placed on computation by each of the books. A summary of the teachers' ratings is given in Table 4-24.

Table 4-24
Grade 12 Teachers' Ratings
of Stress on Computation in Textbooks

Textbook	Too Much	About Right	Too Little
Modern Algebra and Trigonometry II	9.6	80.7	9.6
Introduction to Calculus	4.5	71.6	23.9
Mathematics for a Modern World 1112	11.1	70.4	18.5
Using Advanced Algebra	1.8	94.6	3.6
Pre-Calculus Mathematics	3.8	76.9	19.2

Using Advanced Algebra obtained the highest percent rating as being about right in its treatment of computational skills. As a matter of fact, all five texts obtained quite good ratings on this factor. Only *Introduction to Calculus* was seen by more than twenty percent of its raters as placing too little stress on computation.

The third factor rated by the Grade 12 teachers was the extent of the emphasis placed on problem solving in the various approved texts. Their ratings are presented in Table 4-25.

Table 4-25
Grade 12 Teachers' Ratings
of Emphasis on Problem Solving In Texts

Textbook	Too Much	About Right	Too Little
Modern Algebra and Trigonometry II	8.3	82.1	9.5
Introduction to Calculus	3.0	45.5	51.5
Mathematics for a Modern World 1112	0.0	50.0	50.0
Using Advanced Algebra	0.0	76.4	23.6
Pre-Calculus Mathematics	3.8	76.9	19.2

Two of the texts are viewed by one-half their raters as putting too little emphasis on the topic of problem solving, and *Using Advanced Algebra* was so rated by about twenty-five percent of its users. None of the texts was seen to stress problem solving too much. Three books, *Modern Algebra and Trigonometry II*, *Using Advanced Algebra* and *Pre-Calculus Mathematics*, all were rated as placing the correct amount of emphasis on this factor.

Finally, the Grade 12 teachers rated the five texts with respect to their stress on enrichment. Table 4-26 contains a summary of these ratings.

Table 4-26
Grade 12 Teachers' Ratings
of Emphasis on Enrichment in Texts

Textbook	Too Much	About Right	Too Little
Modern Algebra and Trigonometry II	7.1	75.0	17.9
Introduction to Calculus	1.6	31.7	66.7
Mathematics for a Modern World 1112	0.0	29.0	71.0
Using Advanced Algebra	0.0	54.5	45.5
Pre-Calculus Mathematics	29.0	58.1	12.9

All five of these textbooks are used in Mathematics 12 classes so it cannot be said that a lack of enrichment topics in a given book is due to the fact that it was written for low ability students. In this case a lack of emphasis on enrichment is just that; it is a lack of emphasis on enrichment.

Two of the texts, *Introduction to Calculus* and *Mathematics for a Modern World 1112*, were judged by more than sixty-five percent of their raters to contain too little enrichment material. A third text, *Using Advanced Algebra*, was similarly rated by forty-five percent. *Modern Algebra and Trigonometry II* received the most positive rating. Three-quarters of those responding felt it contained about the correct amount of enrichment material.

4.4 Summary

Almost all teachers of mathematics use one or more textbooks in their teaching. The lowest rates of usage, 90.5% and 91.4%, were found to occur at the Grades 1 and 8 levels respectively. Even considering these two, it is safe to say that the use of textbooks in mathematics classes is universal at all grade levels.

More elementary than secondary teachers prefer to have several prescribed textbooks for a given grade. However, a clear majority of teachers at each level would prefer to have several texts from which to choose rather than just one. Relatively few teachers of mathematics have adopted a multi-text approach to the teaching of mathematics, if by that approach is meant the more or less equal utilization of several texts. A majority of teachers said that they prefer to use one text predominantly and others as the need or occasion arises. An overwhelming majority of teachers agree that there should be made available, an outline of the minimum learning outcomes for mathematics at each level, to guide them in the selection of textbooks, materials, and activities.

Teachers do not require their students to read very extensively from their mathematics textbooks. Among elementary teachers, there is a tendency for those in the higher grades to require more reading than in the lower grades. Among secondary teachers, there is virtually no difference in this respect among teachers at the Grades 8, 10, or 12 levels.

All teachers use their mathematics texts primarily as sources of exercises. They appear to be used less frequently for purposes of reviewing concepts presented in class, and even less frequently to develop new concepts. Teachers at all levels say they do not want textbooks which place greater emphasis upon concepts and principles than upon skills and drill. They particularly want textbooks to provide material for drill and practice.

Teachers' ratings of various characteristics of annotated teacher's editions of mathematics textbooks were positive but tended to decrease as grade level increased. In other words, all teachers seem to appreciate the value of such editions, but they are less important to teachers of the higher grades.

On the whole, teachers are quite satisfied with the textbooks that they are using, although many of them seem to be using texts which are no longer on the prescribed list. The highest rating of dissatisfaction with textbooks occurred at the Grade 8 level where thirty-six percent of the teachers expressed negative opinions.

Teachers were asked to rate the prescribed texts with respect to four factors. In general, the two areas which seemed to be a cause for concern were emphasis on problem solving and on computation. At every grade level, a sizeable proportion of the texts being evaluated was seen to be weak in these two areas.

4.5 Summary of Recommendations

Recommendation 4-1: The Curriculum Development Branch should provide teachers of mathematics with an outline of the minimum learning outcomes at each level or grade to aid them in the selection of mathematics textbooks, materials, and activities.

Recommendation 4-2: The Curriculum Development Branch should conduct a province-wide study to discover the reasons for the apparently widespread lack of acceptance by elementary teachers of the newly revised mathematics curriculum and the textbook series prescribed for its implementation

Recommendation 4-3: Teachers of intermediate mathematics should place more emphasis upon teaching students how to read mathematics texts with understanding.

Recommendation 4-4: The Curriculum Development Branch, school district curriculum specialists, and publishers of mathematics textbooks should take steps to ensure that mathematics textbooks for the elementary grades are designed to be read by the students, inasmuch as it is possible to do so.

Recommendation 4-5: Educational researchers and supervisors of instruction should investigate the ways in which mathematics textbooks are used in the elementary schools in an attempt to clarify the interaction between teacher-based discussion and text-book-based discussion.

Recommendation 4-6: Teachers of secondary mathematics should place more emphasis upon teaching students how to read mathematics texts with understanding.

Recommendation 4-7: The Curriculum Development Branch, school district curriculum specialists, and publishers of mathematics textbooks should take steps to ensure that mathematics textbooks for the secondary grades are designed to be read by the students inasmuch as it is possible to do so.

Recommendation 4-8: Educational researchers and supervisors of instruction should investigate the ways in which mathematics textbooks are used for the teaching of secondary mathematics in an attempt to clarify the relationship between teacher-based discussion and textbook-based discussion.

Recommendation 4-9: Persons responsible for the approval and adoption of mathematics textbooks at the Grade 8 level should take under advisement the concerns expressed by Grade 8 teachers concerning the treatment of computational skills and problem solving in the textbooks.

CHAPTER 5

CLASSROOM INSTRUCTION

Items concerning materials and methods used in class, relative time spent on different mathematics content areas, resources used to develop day-to-day lessons, relative importance of different evaluation techniques are all contained in the classroom instruction section, Part IV, of the Teacher Questionnaire. The discussion in this chapter is organized by item, Items 23-25 on the elementary form and Items 27-42 on the secondary form.

5.1 Time Spent on Various Strands

5.1.1 Elementary Teachers

Respondents were asked to rank five content areas of mathematics according to how much time they spent on each in their mathematics class during the school year. The scale ranged from "Least Time Spent" (1) to "Most Time Spent" (5). The average ranking for each of the four grade levels is presented in Table 5-1 for each of the five content areas.

Table 5-1
Elementary Teachers: Time Spent in Class
on Five Selected Mathematics Content Areas

	Grade 1	Grade 3	Grade 5	Grade 7
Drill on basic number facts*	4.16	4.14	3.65	3.04
Computation*	4.38	4.58	4.64	4.52
Problem solving and applications*	3.23	3.53	3.55	3.80
Geometry*	1.89	1.73	1.73	2.19
Metric measurement*	2.26	2.39	2.43	2.49

* indicates a significant difference at the 0.05 level among respondent groups.

As might be expected, the two most time-consuming items for each of the four grade levels are drill on basic number facts and computation. The time spent, however, is reflected in the Mathematics Assessment test results with the grade 4 and 8 students performing well on whole number computation. The low ranking of geometry, however, is also reflected in the results on the Mathematics Assessment test.

5.1.2 Secondary Teachers

Secondary teachers were also asked to rank five mathematics content areas in the same manner as their elementary school counterparts. The scale ranged from 1 (Least time spent) to 5 (Most time

spent). The average ranking for each of the three grade levels on each of the five content areas is presented in Table 5-2.

Table 5-2
Secondary Teachers: Time Spent in Class
on Five Selected Mathematics Content Areas

	Grade 8	Grade 10	Grade 12
Drill on arithmetic computation*	3.65	2.47	1.84
Problem solving and applications*	3.59	3.93	4.07
Geometry*	2.40	2.70	2.53
Metric measurement*	2.24	2.14	1.76
Algebraic concepts*	3.66	4.24	4.84

* indicates a significant difference at the 0.05 level among the respondent groups

As grade level increases the amount of time spent in class on drill on arithmetic computation and metric measurement decreases. Secondary teachers spend less time on arithmetic computation in class than elementary teachers do, as would be expected. Secondary teachers responded that they spent the least amount of time on metric measurement of those content areas listed.

As grade level increases, the amount of time spent in class on problem solving and applications, and algebraic concepts increases. Algebraic concepts yielded the highest average of the five content areas in each of the three grade levels. The averages for problem solving and applications and algebraic concepts were both over the 4.0 level for grade 12. The next highest average in the grade 12 group was a 2.53 for geometry. The averages for problem solving and applications and algebraic concepts, while not as high as for grade 12, were far higher than any other content area for grade 10 as well.

A comparison of the results for geometry in Tables 5-1 and 5-2 indicates that secondary teachers spend a significantly greater amount of time in class on geometry than elementary teachers do.

5.2 Use of Metric Units

5.2.1 Elementary Teachers

Elementary teachers were asked to select the statement that would best describe their use of units of measurement in their non-mathematics classes. The data relevant to this question are summarized in Table 5-3.

Table 5-3
Elementary Teachers: Use of Metric Units
of Measurement in Non-Mathematics Classes

	Percent Selecting Each Statement:			
	Grade 1	Grade 3	Grade 5	Grade 7
Use metric units only	65.8	52.8	45.0	32.8
Use both metric and British units	30.5	44.8	51.1	63.0
Use British units only	1.4	1.4	2.0	0.8
I teach only mathematics classes	2.3	1.0	2.0	3.3

According to the Curriculum Guide for Mathematics, the metric units of measurement are the only units of measurement to be used in mathematics classes in K-12 by 1978. By 1978 the metric units are to be the predominant units of measurement for all instruction in elementary and secondary schools throughout Canada. The primary grades are over half way toward using only metric units in all instruction. It is not logical to expect the generation of Canadians that is now in elementary schools to think in metric terms if British units of measurement are used in all of their classes except mathematics. Yet fewer than one-third of the Grade 7 teachers use metric units exclusively in all their instruction. As will be seen in the next section, the situation appears to be no better at the secondary level.

5.2.2 Secondary Teachers

The emphasis in introducing the metric system of measurement has been at the elementary school level. In the elementary grades the curriculum objectives include only metric units of measurement (except Grade 7 which includes both metric and British units), the textbooks are completely metric, and many materials are advertised for presenting the metric system to elementary students. These and other factors are missing at the secondary level.

The secondary teachers were asked to respond to all items on the questionnaire in terms of their mathematics class(es). The results presented in Table 5-4 are not comparable to the results presented in Table 5-3 which are based on non-mathematics courses.

Table 5-4
Secondary Teachers: Use of Units of Measurement in Mathematics Classes

	Percent Selecting Each Statement: Grade 8	Grade 10	Grade 12
Use metric units only	48.0	36.9	13.6
Use both metric and British units	50.9	62.0	85.2
Use British units only	1.1	1.1	1.1

There is no mention of units of measurement, British or metric, in the Curriculum Guide for Mathematics in Grade 10 or 12. In Grade 8 the Curriculum Guide requires that both metric and British units be presented. It is not surprising that at none of the three secondary grades surveyed were a majority, or even a plurality, of teachers using metric units exclusively. It is surprising that only about fourteen percent of the Grade 12 teachers use only metric units in their mathematics classes. If the goal stated earlier is to be attained, in less than one year, almost 100% of the secondary mathematics teachers should be using metric units exclusively in their instruction.

5.3 Use of Aids in Planning

5.3.1 Elementary Teachers

Elementary teachers were asked to rank each item in a list of resources according to its usefulness in their planning day-to-day lessons or units in mathematics. The rankings were on a scale from 1 (not useful) to 5 (very useful). The results are presented in Table 5-5.

Of the eleven rows that show statistically significant results, eight are due to the primary teachers having ranked the item higher than the intermediate teachers, and one by the primary teachers ranking the item lower. Using the students' mathematics textbook, while ranked high by all four groups, was ranked lower by the primary teachers. The lower ranking is probably due to the fact that, compared to intermediate level textbooks, very little information concerning the lesson is printed on the pages of primary students' mathematics textbooks.

All four groups ranked the following items higher than 3.5: use of students' textbooks, and use of the accompanying teachers' guidebook. All four groups ranked the following items less than 2.0: school district mathematics specialists and district supervisors.

In addition, primary teachers ranked ideas from in-service activities and ideas from colleagues higher than 3.5.

Table 5-5
Elementary Teachers:
Usefulness of Resources for Planning Lessons

Resource	Average Ranking: Grade 1	Grade 3	Grade 5	Grade 7
Last year's preparation*	3.40	3.23	3.20	3.43
B.C. Mathematics Curriculum Guide*	2.98	3.07	2.72	2.77
B.C.T.F. *Lesson Aids**	2.27	2.36	2.18	2.16
Idea books*	3.61	3.34	3.10	3.02
Ideas from in-service activities*	3.80	3.50	3.09	3.12
Ideas from colleagues*	3.64	3.54	3.24	3.25
Ideas from university courses	2.50	2.45	2.42	2.52
Materials from your district Resource Centre	2.66	2.67	2.55	2.49
Professional journals*	2.35	2.35	2.15	2.18
School district mathematics specialists	1.97	1.91	1.90	1.8[illegible]
District supervisors*	1.95	1.87	1.66	1.63
Students' mathematics textbook*	3.55	3.88	4.03	4.09
Teachers' guidebooks accompanying the different mathematics textbooks*	4.00	3.94	4.00	3.64
Locally developed curriculum guides	2.75	2.80	2.58	2.65
Materials obtained through commercial establishments*	3.13	3.24	2.98	2.83

* indicates a significant difference at the 0.05 level among the respondent groups.

Recommendation 5-1: School districts should explore ways and means of making specialists' services more readily available and of more benefit to elementary teachers.

5.3.2 Secondary Teachers

Secondary teachers were also asked to rank a number of teaching resources according to their usefulness. The scale used ranged from 1 (not useful) to 5 (very useful). Several resources on the elementary list were changed to make the revised list more appropriate for the secondary level, but the response mode was the same. The results for this item are found in Table 5-6.

Table 5-6
Secondary Teachers:
Usefulness of Resources for Planning Lessons

Resource	Average Ranking: Grade 8	Grade 10	Grade 12
Last year's preparation*	3.34	3.57	3.98
B.C. Mathematics Curriculum Guide*	2.84	3.06	3.08
B.C.T.F. *Lesson Aids**	1.81	1.76	1.50
The provincially adopted textbooks for students*	3.77	3.91	4.28
The teachers' guidebook accompanying the provincially adopted textbooks	2.33	2.55	2.76
Mathematics books which are not provincially adopted	3.16	3.34	3.33
Mathematics books which are not textbooks	2.78	2.81	2.89
Ideas from in-service programmes	2.62	2.62	2.64
Ideas from university courses*	2.24	2.43	2.68
Materials from your district Resource Centre	1.90	1.83	1.69
Professional journals*	2.16	2.48	2.63
School district mathematics specialists*	1.79	1.66	1.49
District supervisor*	1.39	1.32	1.18
Locally developed curriculum guides*	2.65	2.60	2.13
Materials obtained through commercial establishments	2.80	2.70	2.69

* indicates a significant difference at the 0.05 level among respondent groups.

Unlike the elementary teachers, there is no one group of secondary teachers that ranks items consistently higher or lower than the others, thereby causing most of the nine statistically significant differences. The Grade 8 teachers ranked one of the nine items higher and two items lower than the other two groups. The Grade 12 teachers ranked one item higher and two items lower than the other two groups.

Four items were given an average ranking of less than 3.0 and all three groups ranked them as such. The four items were B.C.T.F. *Lesson Aids*, materials from district Resource Centres, school district mathematics specialists, and district supervisors. The last two items are the two that were also ranked low by the elementary teachers.

One item was given a high ranking by all three groups: the provincially adopted textbooks for the students. In addition, Grade 10 and Grade 12 teachers ranked last year's preparation higher than 3.5.

Recommendation 5-2: School districts should explore ways and means of making specialists' services more readily available and of more benefit to secondary teachers.

5.4 Factors Influencing Mathematics Instruction

5.4.1 Elementary Teachers

The elementary teachers were presented a list of sixteen factors purported to affect mathematics instruction and asked to rate the factors on a five-point scale (1 = low priority, 5 = high priority) according to the priority they would give each, based on the effect it has on the success of their mathematics programme. The average rating for each factor is presented in Table 5-7.

Table 5-7
Elementary Teachers:
Factors Influencing Mathematics Instruction

Factors	Average Ranking: Grade 1	Grade 3	Grade 5	Grade 7
Reduction of class size	4.24	4.28	4.24	4.17
Greater release time for lesson preparation	3.57	3.71	3.60	3.49
More clerical assistance	2.53	2.63	2.61	2.51
Better library services	2.12	2.08	2.05	2.10
Reduction of total pupil load*	3.82	3.90	3.68	3.62
Improvement of physical facilities*	2.80	2.82	2.54	2.49
Textbooks more suited to instructional needs*	3.37	3.83	3.76	3.82
Increasing time allotment for mathematics*	2.46	2.70	2.86	2.81
More effective teacher education pre-service programmes	3.49	3.57	3.44	3.32
More effective in-service and professional development	3.63	3.70	3.57	3.51
More release time for in-service and professional development*	3.56	3.68	3.40	3.32
Curriculum guides that offer more assistance in the instructional process	3.57	3.67	3.53	3.56
Curriculum guides that outline content in specific terms	3.56	3.71	3.65	3.61
More Learning Assistance Services	3.21	3.37	3.32	3.22
More mathematics manipulative materials for individual classrooms*	4.29	4.14	3.79	3.66
Ability grouping of students for classes*	3.08	3.39	3.44	3.59

* indicates a significant difference at the 0.05 level among respondent groups.

Of the seven statistically significant differences, four were were caused by the primary teachers ranking the factors higher than the intermediate teachers. One was caused by the primary teachers, in particular the grade one teachers, ranking the factor lower; and the other two were caused by the grade one teachers ranking the factor much lower than the other three groups.

All four groups gave eight factors a rating greater than 3.5 and no group gave an average ranking of less than 2.0 to any factor. The eight factors ranked highest by all four groups in order of priority were reduction of class size, more mathematics manipulative materials for individual classrooms, reduction of total pupil load, textbooks more suited to instructional needs, curriculum guides that outline content in specific terms, more effective in-service and professional development, more release time for lesson preparation, and curriculum guides that offer more assistance in the instructional process.

In addition, the primary teachers ranked more effective teacher education pre-service programmes and more release time for in-service and professional development higher than 3.5.

The factor with the lowest average ranking was better library services with an average rating of 2.09. As shown in Table 5-7, there was no statistically significant difference on this factor, meaning that all four groups were in agreement. This low rating could indicate either that library service is already good or that elementary teachers do not use the library for their mathematics classes.

These elementary teachers have a number of recommendations to make to various groups of people concerning factors which influence mathematics instruction. Textbook authors need to try to make textbooks more suited to instructional needs. Curriculum developers need to produce guides that outline the content in more specific terms and that offer more assistance in the instructional process. School boards need to explore ways of reducing class size and total pupil load and of providing more mathematics manipulative materials for individual classrooms and more release time for lesson preparation. Teacher education institutions need to provide more effective teacher education programmes, especially for primary education students. The universities, teachers and school board personnel need to combine their efforts to provide more effective in-service and professional development.

5.4.2 Secondary Teachers

Secondary teachers were asked to rate the same sixteen factors as the elementary teachers using the same type of scale. The results for the item on the secondary form of the questionnaire are presented in Table 5-8.

Table 5-8
Secondary Teachers:
Factors Influencing Mathematics Instruction

	Average Ranking:		
	Grade 8	Grade 10	Grade 12
Reduction of class size*	4.26	4.02	3.78
Greater release time for lessson preparatiou	3.24	3.40	3.16
More clerical assistance	2.65	2.76	2.59
Better library services	2.15	2.41	2.18
Reduction of total pupil load	3.73	3.54	3.47
Improvement of physical facilities*	3.02	3.10	2.66
Textbooks more suited to instructional needs*	4.06	4.10	3.75
Increasing time allotment for mathematics*	2.86	3.07	3.73
More effective teacher education pre-service programmes*	3.34	3.16	2.83
More effective in-service and professional development*	3.46	3.42	3.13
More release time for in-service and professional development	3.25	3.28	3.01
Curriculum guides that offer more assistance in the instructional process*	3.40	3.36	2.65
Curriculum guides that outline content in more specific terms*	3.51	3.50	3.07
More Learning Assistance services*	3.28	2.96	2.45
More mathematics manipulative materials for individual classrooms*	3.46	3.27	2.77
Ability grouping of students for classes*	3.96	3.93	3.62

* indicates a significant difference at the 0.05 level among respondent groups.

There were eleven items yielding statistically significant differences, of which five items yielded statistically significant differences on both the elementary and secondary forms of the questionnaire. Those five items concerned increasing time allotments for mathematics, more mathematics manipulative materials for individual classrooms, improvement of physical facilities, textbooks more suited to instructional needs, and ability grouping of students for classes.

Of the eleven statistically significant differences, eight were caused by the grade 12 teachers ranking the item significantly

lower than teachers of the other two grades did.

All three groups gave three items a rating in excess of 3.5. The three items were reduction of class size, textbooks more suited to instructional needs, and ability grouping of students for classes. The first two also received high rankings from the primary and intermediate teachers. It is common practice in the elementary classroom to organize the mathematics class into smaller groups based on some measurement of ability. As a result, elementary teachers did not rank ability grouping of students for classes as a high priority, though the grade seven teachers did give it a rating of 3.59. On the other hand, total class instruction is very common in the secondary mathematics classroom (93% of the secondary teachers responding marked that they used total class instruction frequently, see Section 5.5.2) and the secondary teachers ranked ability grouping of students for classes as the third highest item on the priority list of sixteen items.

The grade 8 and 10 teachers also ranked reduction of total pupil load and curriculum guides that outline content in more specific terms as being of high priority. The grade 12 teachers ranked increasing time allotment for mathematics as being of high priority.

As with the elementary teachers, no item had an average rating lower than 2.0. The item with the lowest overall average (2.19) was, again, better library services.

5.5 Use of Teaching Aids

5.5.1 Elementary Teachers

The list of aids used in teaching mathematics was organized into three categories: media, materials, and methods. The elementary teachers were asked to respond to each item on the list according to whether they used the item frequently, infrequently, or not at all. The data presented in Tables 5-9 to 5-14 are averages computed by assigning the following scores:

Response	Score
Not at all	1
Infrequently	2
Frequently	3

Figure 5-1: Response Scores

Media

Six different media were listed as possible aids for mathematical instruction. The data regarding use of these aids are listed in Table 5-9.

Of the six items listed over half the primary teachers had not used five. The chalkboard, as expected, is by far the most common medium used in the mathematics classroom at all levels. The overhead projector is being used to some extent probably as an alternative to the chalkboard. One primary teacher in ten, one Grade 5 teacher in five, and one Grade 7 teacher in four responded that they use the overhead projector frequently. Films and filmstrips are not being used frequently by the elementary teachers. Only five of the almost 2000 elementary teachers responding make frequent use of television in their teaching of mathematics.

Table 5-9
Elementary Teachers: Use of Media

	Grade 1	Grade 3	Grade 5	Grade 7
Television*	1.10	1.10	1.16	1.20
Films*	1.36	1.41	1.46	1.47
Filmstrips (or loops)	1.50	1.51	1.50	1.52
Overhead projector*	1.54	1.55	1.86	2.02
Opaque projector	1.21	1.21	1.27	1.26
Chalkboard	2.95	2.98	2.94	2.96

* indicates a significant difference at the 0.05 level among the respondent group.

Materials

Thirteen items were listed as materials that might serve as aids in elementary mathematics instruction. The results for the items concerning materials are summarized in Table 5-10.

Table 5-10
Elementary Teachers: Use of Materials

	Grade 1	Grade 3	Grade 5	Grade 7
Hand-held calculators*	1.09	1.12	1.22	1.41
Commercially prepared handouts*	1.86	1.98	2.03	1.94
Teacher-prepared handouts	2.80	2.81	2.77	2.76
Teacher-prepared games*	2.78	2.69	2.35	2.12
Teacher-prepared workcards*	2.65	2.58	2.23	2.03
Base 10 blocks*	1.89	1.62	1.36	1.18
Cuisenaire rods*	1.73	1.46	1.20	1.11
Metric equipment	2.39	2.44	2.43	2.41
Attribute blocks*	2.06	1.53	1.31	1.21
Abacus*	1.85	1.50	1.40	1.22
Solid geometric shapes*	2.17	1.94	1.85	1.87
Dice*	2.24	2.06	1.62	1.56
Playing cards*	1.98	1.93	1.58	1.49

* indicates a significant difference at the 0.05 level among the respondent groups.

Hand-held calculators, which are currently a topic of discussion at almost all mathematics conferences, are used more frequently by intermediate teachers than primary teachers, as expected. However, less than five percent of the intermediate teachers use hand-held calculators frequently. A separate discussion of results on items specifically concerned with the use of hand-held calculators is presented in Section 5.6 of this report.

The materials used most frequently by primary teachers are teacher-prepared. The three teacher-prepared items, teacher-prepared handouts, teacher-prepared games, and teacher-prepared workcards, were used frequently by over twenty-five percent more teachers than the next most commonly used item, metric equipment.

For intermediate teachers, only one item on the list of materials stands out from the rest. Teacher-prepared handouts are used frequently by over thirty percent more intermediate teachers than the next most commonly used item. Metric equipment and the other teacher-prepared items are, however, the next three highest ranked items as they were with the primary teachers.

Cuisenaire rods, at one point quite common in the elementary classroom, are not used at all by a majority of the elementary teachers, with over ninety percent of the grade seven teachers responding that they did not use them at all.

Methods

Six methods of presenting mathematics to an elementary class were listed, and the teachers responded with respect to the frequency of use of each method in their classes. The results are presented in Table 5-11.

Table 5-11
Elementary Teachers:
Use of Different Instructional Methods

	Grade 1	Grade 3	Grade 5	Grade 7
Learning Centres*	2.26	2.05	1.73	1.55
Individualized instruction	2.68	2.69	2.65	2.69
Laboratories*	1.14	1.15	1.23	1.25
Total class instruction	2.68	2.71	2.71	2.74
Team teaching	1.20	1.19	1.18	1.17
Computer-aided instruction	1.03	1.04	1.06	1.07

* indicates a significant difference at the 0.05 level among the respondent groups.

The percent of teachers who do not use learning centres at all increases as grade level increases, starting with about sixteen percent in Grade 1 to about fifty-one percent in Grade 7. While it is true that as grade level increases the percent of teachers who use laboratories increases, over three-fourths of Grade seven teachers do not use laboratories.

One interesting comparison that can be made is between the percent of teachers responding that they use individualized instruction frequently and total class instruction frequently. While the two approaches appear to be incompatible they are both used frequently by a large majority of the teachers. Total class instruction was the method most teachers at each grade level marked that they used frequently and individualized instruction was second. Moreover, individualized instruction was used frequently by almost twenty-nine percent more Grade 1 teachers than the next most commonly used method, learning centres; this same pattern held for all grades with the difference expanding to sixty-five percent for Grade 7.

The least-used methods are team teaching, over eighty-six percent of the teachers do not use team teaching at all, and computer-aided instruction, over ninety-five percent of the teachers do not use computer-aided instruction at all.

5.5.2 Secondary Teachers

As with the elementary form of the questionnaire, the list

of aids used in teaching mathematics was organized into three categories: media, materials, and methods. The secondary mathematics teachers responded to each item in the list according to whether they used the item frequently, infrequently, or not at all. The data presented in Tables 5-12 to 5-14 are the averages based on the scores defined in Figure 5-1.

Media

The same six media items were used for both the elementary and secondary teachers. The data from the secondary mathematics teachers concerning the use of media are presented in Table 5-12.

Table 5-12
Secondary Teachers: Use of Media

	Grade 8	Grade 10	Grade 12
Television	1.04	1.07	1.07
Films	1.27	1.32	1.26
Filmstrips (or loops)	1.30	1.34	1.31
Overhead projector*	1.81	2.03	2.05
Opaque projector	1.12	1.11	1.11
Chalk board	2.95	2.93	2.94

* indicates a significant difference at the 0.05 level among the respondent groups

Over two-thirds of the secondary mathematics teachers indicated that they did not use any of the six items on the list at all. Over ninety percent of the secondary teachers had not used television at all and no secondary mathematics teachers responded that they used television frequently. The chalkboard is the most popular medium for presenting mathematics instruction with about ninety-five percent of secondary teachers responding that they use the chalkboard frequently. The overhead projector, however, seems to be making inroads as an alternative to the chalkboard among secondary mathematics teachers. One out of every five Grade 8 teachers and about one out of every three Grade 10 and 12 teachers use the overhead projector frequently. Over the three grade levels, thirty-three percent of the teachers responded that they never use the overhead projector compared to forty-three percent of the elementary teachers.

Materials

Eight items were listed as materials that might serve as aids in mathematics instruction. The data for the items dealing with materials are summarized in Table 5-13.

Table 5-13
Secondary Teachers: Use of Materials

	Grade 8	Grade 10	Grade 12
Hand-held calculators*	1.59	2.03	2.47
Commercially prepared handouts*	1.81	1.70	1.45
Teacher-prepared handouts	2.87	2.82	2.74
Teacher-prepared games*	2.04	1.92	1.66
Teacher-prepared workcards*	1.69	1.59	1.47
Metric equipment*	1.96	1.89	1.57
Computer*	1.17	1.18	1.43
Slide rules	1.11	1.24	1.66

* indicates a significant difference at the 0.05 level among the respondent groups.

Hand-held calculators are beginning to be used in mathematics classes. As grade level increases, so does the use of hand-held calculators. The percent of teachers who use hand-held calculators frequently increases from about nine percent in Grade 8 to about fifty-seven percent in Grade 12. The percent of teachers who do not use hand-held calculators at all drops from about fifty percent in Grade 8 to about ten percent in Grade 12. A discussion of the results on items specifically concerned with hand-held calculators is presented in Section 5.6 of this chapter.

Teacher-prepared handouts yielded the highest average in each of the three groups. Sixty-three percent more Grade 8 teachers indicated that they used teacher-prepared handouts than any other materials item.

Over the last decade, the use of the computer in secondary schools has increased rapidly. In spite of this, about eighty-six percent of the Grade 8 mathematics teachers and about eighty-three percent of the Grade 10 mathematics teachers do not use the computer at all. A discussion of the results on items specifically concerned with the use of the computer in secondary mathematics classes is presented in Section 5.6 of this chapter.

Methods

Six methods of presenting mathematics to a secondary class were listed and the teachers responded according to frequency of use of each method in their classes. The results are presented in Table 5-14.

Table 5-14
Secondary Teachers:
Use of Different Instructional Methods

	Grade 8	Grade 10	Grade 12
Learning centres	1.23	1.22	1.24
Individualized instruction	2.50	2.50	2.43
Laboratories	1.24	1.28	1.25
Total class instruction	2.92	2.91	2.98
Team teaching	1.09	1.15	1.14
Computer-aided instruction*	1.10	1.11	1.29

* indicates a significant difference at the 0.05 level among the respondent groups.

Of the six methods listed for presenting mathematics to a secondary class, four are not being used by any sizable group of secondary mathematics teachers. Over seventy-five percent of the secondary mathematics teachers do not use learning centres or laboratories at all. Over ninety percent of the Grade 8 teachers do not use team teaching or computer-aided instruction at all. Team teaching and computer-aided instruction are not used at all by eighty-seven percent and ninety percent respectively, of the Grade 10 teachers and eighty-six percent and seventy-three percent, respectively, of the Grade 12 teachers.

As discussed in Section 5.5.1 of this chapter, total class instruction and individualized instruction may appear to be incompatible, but those are the two methods most widely used by both the elementary and secondary teachers surveyed. Unlike elementary teachers, however, secondary mathematics teachers make a much more extensive use of total class instruction. Total class instruction is used frequently by over ninety percent of secondary mathematics teachers, with almost ninety-eight percent of the Grade 12 teachers responding that they use it frequently. Though individualized instruction was the second most commonly used method and was used frequently by about forty-five to fifty-five percent more secondary teachers than the next most commonly used method, it was still used frequently by thirty-five to forty percent fewer teachers than total class instruction.

The only major differences between elementary and secondary teachers surveyed with respect to methods used are that elementary teachers use learning centres more frequently and secondary teachers make more use of total class instruction. With respect to materials, the secondary teachers make more use of hand-held calculators than the elementary teachers and the elementary teachers make more use of teacher-prepared workcards than the secondary teachers. In the area of media, elementary teachers make more use of film and filmstrips

than secondary teachers, but neither group uses them extensively. Secondary teachers make more use of the overhead projector than elementary teachers.

Recommendation 5-8: Teachers of mathematics at all levels should vary their teaching approaches to include such techniques as the use of learning centres and mathematics laboratory activities. Teacher educators should encourage their student teachers to develop the skills required to use such techniques.

5.6 Use of Calculators and Computers

5.6.1 Elementary Teachers

Since the price of hand-held calculators dropped to the point at which people began buying them for their personal use, there has been much concern about the effect these computing devices would have on students, especially with respect to their computational abilities. Four items concerned with the use of hand-held calculators in the mathematics classes in the elementary schools were included on the questionnaire. The four questions dealt with whether the teachers used hand-held calculators in their own work, at what level the teachers felt students should be allowed to use hand-held calculators, in which ways teachers allowed students to use hand-held calculators in their mathematics classes, and in which ways the teachers used hand-held calculators in their mathematics classes.

The teachers' responses to the question "Do you use a hand-held calculator in your own work?" are summarized in Table 5-15.

Table 5-15
Elementary Teachers:
Personal Use of Hand-Held Calculators (Percent)

	Grade 1	Grade 3	Grade 5	Grade 7
Yes*	29.5	25.4	38.0	55.0

* indicates a significant difference at the 0.05 level among the respondent groups.

Elementary teachers were then asked to specify at which levels they felt students should be permitted to use hand-held calculators in their mathematics classes. The first choice was "At no level". If teachers selected the first choice, they skipped the remaining two questions concerning the use of hand-held calculators. These results are presented in Table 5-16.

Table 5-16
Elementary Teachers:
Levels at Which Students Should be Allowed to Use Hand-Held Calculators

	Grade 1	Grade 3	Grade 5	Grade 7
At no level*	20.1	18.4	19.5	11.8
Primary*	9.5	9.6	5.9	6.1
Intermediate*	20.1	18.2	22.5	30.5
Junior Secondary	38.3	39.3	37.8	44.3
Senior Secondary*	60.6	62.7	59.5	70.1

* indicates a significant difference at the 0.05 level among respondent groups.

The chief factor in the statistically significant differences in the data in rows 1 and 5 appears to be the responses of the Grade 7 teachers. In row 1, a lower percentage of Grade 7 teachers as compared to the other three groups, feel that hand-held calculators should not be used by students at any of the four levels listed. That result is reflected in row 5 where seventy percent of the Grade 7 teachers responded that senior secondary students should be allowed to use hand-held calculators. In row 3 the lowest percentage of positive response is by the Grade 3 teachers, but again the Grade 7 teachers yielded the highest percent of positive response. All four groups gave their lowest response to the primary level, indicating that they felt primary students should not be allowed to use hand-held calculators. In fact, the senior secondary level students are the only group that received a majority response that they should be allowed to use hand-held calculators.

Only those teachers who felt that one or more of the four levels was appropriate for students to use hand-held calculators responded to the next two questions.

Ten different ways a student might use a hand-held calculator in a mathematics class were listed, and the teachers were asked to indicate which of the ten ways students were allowed to use hand-held calculators in their mathematics classes. The results for that item are listed in Table 5-17. Since the teachers could respond to any number of the items listed in Table 5-17, the sum of the columns may exceed 100%.

The major factor in four of the eight statistically significant differences is the response of the Grade 7 teachers. In all four cases the percent of Grade 7 teachers responding positively was significantly greater than the other three groups. Overall, a greater percent of Grade 7 teachers responded on eight of the nine applications of hand-held calculators. The application they were not highest on

was allowing students unrestricted use. Grade 7 teachers were the lowest on the first choice, students do not use hand-held calculators in my mathematics class.

Table 5-17
Elementary Teachers:
Students' Use of Hand-Held Calculators (Percent)

	Grade 1	Grade 3	Grade 5	Grade 7
Students do not use hand-held calculators in my mathematics class*	77.5	78.2	66.1	52.5
Unrestricted use	1.0	1.5	0.5	0.9
To check work*	2.7	8.3	17.5	23.0
To shorten computation time and effort in class work*	0.5	0.7	4.5	11.1
To shorten computation time and effort on tests	0.0	0.2	0.5	0.5
To shorten computation time and effort on non-test assignments*	0.2	1.5	5.2	14.1
To shorten computation time and effort so that more concepts may be covered*	0.7	1.2	2.8	7.4
To shorten computation time and effort so that a concept may be covered in more depth*	1.5	1.0	4.0	8.1
To drill on computation facts*	1.5	4.4	5.7	6.9
To offer enrichment problems*	4.0	7.1	12.6	27.0

* indicates a significant difference at the 0.05 level among respondent groups.

The ways in which students are not allowed to use hand-held calculators is quite clear. Students are not permitted unrestricted use of hand-held calculators, and they are not allowed to use hand-held calculators to shorten computation time and effort on tests. These were the only two items in Table 5-17 on which all four groups agreed.

By far the two most common uses of hand-held calculators are to check work and to offer enrichment problems. The next two most common uses are to shorten computation time and effort on non-test assignments, and class work.

On the next item, teachers were presented with three ways in which an elementary teacher could make use of hand-held calculators in the mathematics classroom. The teachers were asked to select from the list the ways they used hand-held calculators in their mathematics classes. The results of that item are presented in Table 5-18.

In each case as grade level increases, so does the percent of positive response. Grade 7 teachers not only have the greatest

positive response in every case, but the difference between the responses of Grade 5 and 7 teachers is the greatest difference between two consecutive grade levels. The major factor in all three significant differences is the response of the Grade 7 teachers.

Table 5-18
Elementary Teachers:
Teacher Use of Hand-Held Calculators (Percent)

	Grade 1	Grade 3	Grade 5	Grade 7
To do the computation so the concept can be emphasized*	0.7	2.2	6.6	16.7
To do the computation so many more examples of a concept may be shown*	1.2	2.9	6.4	11.5
To show students how to use hand-held calculators*	4.0	8.8	10.0	22.4

* indicates a significant difference at the 0.05 level among respondent groups.

Interestingly, the major use of hand-held calculators in all three grades was not for mathematics instruction, but for how to use a hand-held calculator.

5.6.2 Secondary Teachers

Secondary teachers responded to the same four hand-held calculator questions as the elementary teachers did. In addition, they responded to two items concerned with the use of computers in secondary school mathematics classes. The results for the hand-held calculators will be discussed first.

Hand-Held Calculators

Teachers were asked to respond to the question "Do you use a hand-held calculator in your own work?" The results for this item are presented in Table 5-19.

Table 5-19
Secondary Teachers:
Personal Use of Hand-Held Calculators (Percent)

	Percent Responding:		
	Grade 8	Grade 10	Grade 12
Yes	72.9	79.0	79.3

The percent of secondary mathematics teachers who responded positively to this question was more than double the percentage of elementary teachers who responded positively to the same question.

The teachers were then asked to select from a list of four levels those at which students should be allowed to use hand-held calculators in their mathematics classes. If the teachers felt that calculators should not be used at any level, they were asked to omit the remaining two questions concerning the use of hand-held calculators.

Table 5-20
Secondary Teachers:
Level at Which Students Should be Allowed to Use Hand-Held Calculators
(percent)

	Grade 8	Grade 10	Grade 12
At no level	11.2	6.9	5.6
Primary	5.0	5.8	5.6
Intermediate	10.2	10.9	10.1
Junior Secondary*	41.3	53.8	39.3
Senior Secondary*	79.6	88.0	89.9

* indicates a significent difference at the 0.05 level among respondent groups.

The three groups of secondary teachers are in agreement that students should not be allowed to use hand-held calculators while in elementary school. The statistically significant difference at the Junior Secondary level appears to be caused by a greater percentage of Grade 10 teachers stating that the junior secondary level is an appropriate one for students to use hand-held calculators. The statistically significant difference at the senior secondary level is due to a difference in strength of opinion rather than a difference of opinion. The significant difference is caused by a lower percentage of Grade 10 teachers responding positively; however, almost eighty percent of the Grade 10 teachers did respond positively.

Comparing the results presented in Tables 5-16 and 5-20, there can be little doubt that the higher the grade level, the more appropriate teachers feel it is for students to be allowed to use hand-held calculators in mathematics classes. In all seven groups of teachers surveyed, the higher the level the greater the percent responding that students at the specified level should be allowed to use hand-held calculators.

Only those teachers who felt that one or more of the four levels listed in this item were appropriate for students to use hand-

held calculators responded to the next two questions.

Ten different ways in which a student might use a hand-held calculator in a mathematics class were listed. Secondary teachers were asked to indicate in which of the ten ways their students were allowed to use hand-held calculators in mathematics classes. The results for this item are summarized in Table 5-21.

Table 5-21
Secondary Teachers: Student Use of Hand-Held Calculators (Percent)

	Grade 8	Grade 10	Grade 12
Students do not use hand-held calculators in my mathematics class*	50.6	24.2	1.2
Unrestricted use*	2.4	7.8	11.9
To check work*	26.5	47.7	41.7
To shorten computation time and effort in class work*	28.2	50.0	85.7
To shorten computation time and effort on tests*	5.9	14.1	25.0
To shorten computation time and effort so that more concepts may be covered*	18.2	34.8	58.3
To shorten computation time and effort so that a concept may be covered in more depth*	17.9	35.5	54.8
To drill on computation facts	5.3	3.5	2.4
To offer enrichment problems*	20.3	32.0	33.3

* indicates a significant difference at the 0.05 level among respondent groups.

All but the first choice were used by those teachers who actually allowed students to use hand-held calculators in class, but the percents in Table 5-21 are based upon all the teachers who responded. To adjust the responses to include only those teachers who actually allowed the use of hand-held calculators would mean that any percentage response exceeding 25% for the Grade 8 teachers, 38% for the Grade 10 teachers, and 49% for the Grade 12 teachers would represent a majority of the teachers at that level.

There is only one row in Table 5-21 that does not have a statistically significant difference. None of the three groups make much use of hand-held calculators to drill on computation facts. It also appears that students are not allowed unrestricted use of hand-held calculators, one of the restrictions being the use of the calculators by students during tests.

The two most common uses of calculators were to shorten computational time and effort in class work, with an overall adjusted percent response of sixty-six percent, and non-test assignments, overall adjusted percent response of sixty-five percent. The only

other application to attain an overall adjusted percent response greater than fifty percent was that of checking work.

In comparing the results in Table 5-17 and 5-21, adjusted to include only those teachers who allow their students to use hand-held calculators in mathematics class, several trends become evident. Elementary teachers and secondary teachers do not make much use of hand-held calculators to drill on computation facts. Both elementary and secondary teachers use hand-held calculators to offer enrichment problems. Two of the uses listed for hand-held calculators were directly involved with the presentation of mathematics lessons. Those two uses were to shorten computation time and effort so that more concepts could be covered or so that concepts could be covered in more depth. On those two uses of hand-held calculators, the percent of secondary mathematics teachers' positive response was four times that of elementary teachers.

Finally, secondary teachers were presented with three ways in which secondary mathematics teachers might use hand-held calculators in their classes. They were asked to select all of those options which they used in their classes. The results are summarized in Table 5-22.

Table 5-22
Secondary Teachers: Teacher Use of Hand-Held Calculators (percent)

	Grade 8	Grade 10	Grade 12
To do the computation so that the concept can be emphasized*	25.0	42.6	64.3
To do the computation so many more examples of a concept may be shown*	21.5	38.7	54.8
To show students how to use hand-held calculators	25.9	31.7	31.0

* indicates a significant difference at the 0.05 level among the respondent groups.

The two statistically significant differences were due to the percent responses of the three groups being well spaced. In both instances the percent responses increased with grade level.

Unlike elementary teachers and Grade 8 teachers, Grade 10 and 12 teachers gave the lowest percent to using hand-held calculators to show students how to use hand-held calculators. The Grade 10 and 12 teachers use hand-held calculators to do computation so that the concepts to be presented can be emphasized and more examples of the concepts can be given. All three uses receive equivalent percent responses from Grade 8 teachers.

Computers

The next questionnaire item concerned the ways computers are used in secondary schools for instructional purposes. A subsequent item dealt with how those teachers who make use of the computer in their mathematics class do so. The results for the first of these two items are presented in Table 5-23.

Table 5-23
Secondary Teachers:
Computer Uses in Schools for Instructional Purposes (Percent)

	Grade 8	Grade 10	Grade 12
A computer is NOT used in the school*	73.9	72.0	53.9
A computer is used by a computer club or other extra-curricular organization*	10.7	7.3	16.9
A computer is used in some mathematics classes*	17.8	17.8	33.7
A computer is used in some non-mathematics classes*	7.3	9.8	20.2
A computer is used in a computer science course*	14.4	16.8	37.1

* indicates significant difference at the 0.05 level among the respondent groups.

Those teachers responding to the first choice did not respond to any of the other choices nor did they respond to the next item. To adjust the results in Table 5-23 to include only those teachers who responded that their school did use a computer for instructional purposes means that any response greater than 13% for Grade 8, 14% for Grade 10, and 24% for Grade 12 represents a majority of those teachers for the specified grade level. The fact that for every statistically significant difference on an item listing a way the computer can be used in a school for instructional purposes the Grade 12 teachers' response percent was highest, may be a result of the computer being housed in or more accessible to senior secondary schools.

It is interesting to note that of those schools making use of the computer, most have begun using the computer in both mathematics and non-mathematics classes. Over sixty percent are even offering computer science classes. In considering the results in this section, however, it should be remembered that over seventy percent of the secondary mathematics teachers surveyed responded that a computer is not being used in their schools.

Teachers were then asked to select from a list of several options, those ways in which they made use of computers in their classes. The results of this question are presented in Table 5-24.

Table 5-24
Secondary Teachers:
Computer Use in Secondary Mathematics Classes (Percent)

	Grade 8	Grade 10	Grade 12
Students do not use a computer in my mathematics class	59.0	59.7	48.8
Students take a computer programming unit	25.0	16.9	9.8
Students 'run' pre-written programs	13.0	13.0	7.3
Students use the computer to solve problems that are a part of my mathematics course*	10.0	19.5	29.3
Students do projects using the computer	13.0	15.6	22.0

* indicates a significant difference at the 0.05 level among the respondent groups.

Of the secondary mathematics teachers responding to the questionnaire, over seventy percent did not respond to this item because their school did not use a computer for instructional purposes. Of the approximately twenty-nine percent of the total respondents who did respond, fifty-seven percent indicated that they did not use a computer in their mathematics classes. A percent response greater than 21% for Grade 8, 21% for Grade 10, and 27% for Grade 12 would represent a majority of those teachers responding that they do use a computer in their mathematics classes. Only two of the responses in Table 5-19 represent majority responses. Interestingly, there is only one statistically significant difference among the responses of the three groups. Secondary teachers who use computers in their mathematics classes seem to do so in similar fashion.

The most common use of the computer in secondary mathematics classes is to provide a programming unit in the course. The next two most common uses are to use the computer to solve problems that were a part of the course and to do projects.

5.7 Evaluation Techniques

5.7.1 Elementary Teachers

Eight different evaluation techniques were presented on the elementary form of the questionnaire. Teachers were asked to mark each on a scale from 1 (Not Important) to 5 (Very Important) according to the technique's importance in their mathematics program. The results are presented in Table 5-25.

Of the six statistically significant differences found in Table 5-25, three are caused by intermediate teachers ranking the

items significantly lower than primary teachers. One was caused by intermediate teachers ranking the item significantly higher than primary teachers, and two were caused by Grade 1 teachers ranking the item significantly lower than the other three groups did. In one of these cases, the Grade 7 teachers ranked the technique significantly higher than the other three groups.

Table 5-25
Elementary Teachers: Ranking Evaluation Techniques

	Grade 1	Grade 3	Grade 5	Grade 7
Standardized mathematics tests*	2.35	2.77	3.08	3.07
Teacher-prepared tests*	4.22	4.51	4.59	4.73
Tests prepared at the school district level	2.44	2.55	2.51	2.43
Tests prepared for use throughout your school	2.33	2.53	2.51	2.37
Performance on day-to-day activities*	4.87	4.86	4.70	4.57
Teacher observation of students' work*	4.93	4.89	4.72	4.59
Teacher-prepared checklists*	4.34	4.26	3.96	3.62
Commercially prepared inventories*	1.63	1.89	1.87	1.94

* indicates a significant difference at the 0.05 level among the respondent groups.

The eight evaluation techniques may be divided into two groups, teacher-prepared and other-prepared. It is clear that the four teacher-prepared techniques were ranked much higher than the other-prepared ones. In fact, the overall average for the teacher-prepared items was 4.52, while the overall average for the other-prepared items was 2.39. In order of preference the teachers preferred teacher observations of students' work, performance on day-to-day activities, teacher-prepared tests, and teacher-prepared checklists.

The only technique to be ranked low in importance, less than 2.0, was the use of commercially produced inventories and it was ranked low by all four groups. A complaint often heard from teachers about all other-prepared material is that though the material may have a sound statistical basis and be very objective, it does not exactly fit the situation that exists in the classroom.

5.7.2 Secondary Teachers

Secondary teachers were also presented a list of four teacher-prepared evaluation techniques and four other-prepared evaluation techniques. Seven of the eight were identical to the ones presented to the elementary teachers. The averages obtained on the secondary form of the questionnaire are presented in Table 5-26.

Table 5-26
Secondary Teachers: Ranking of Evaluation Techniques

	Grade 8	Grade 10	Grade 12
Standardized mathematics tests	2.77	2.56	2.55
Teacher-prepared tests	4.82	4.85	4.85
Tests prepared at the school district level	2.08	1.86	1.84
Tests prepared for use throughout your school	3.03	3.06	3.37
Performance on assignments*	4.00	3.89	3.63
Teacher observations of students' work*	3.95	3.73	3.63
Teacher-prepared checklists*	2.74	2.51	2.00
Commercially prepared inventories*	1.53	1.51	1.25

* indicates significant difference at the 0.05 level among the respondent groups.

Three of the four statistically significant differences appear to be caused by the Grade 12 teachers rating the items lower than the other two groups. On the fourth item yielding a statistically significant difference , the Grade 8 teachers rated the item higher than the other two groups.

All three groups agreed that the use of teacher-prepared tests was the single most important evaluation technique listed. All three groups rated performance on assignments and teacher observations of students' work as important. Although both techniques were rated as important, the groups' averages were statistically different with Grade 8 teachers attaching the most importance and Grade 12 teachers the least importance to both techniques.

All three groups gave the least importance to commercially prepared inventories. In addition, the Grade 10 and 12 teachers gave little importance to tests prepared at the school district level. The Grade 12 teachers' average for teacher-prepared checklists was exactly 2.00.

The elementary teachers' average for all four teacher-prepared items were greater than 4.0. The secondary teachers yielded only one average greater than 4.0: teacher-prepared tests had an average ranking of 4.84. The average for teacher-prepared tests was almost a full point above the next highest average, performance on assignments at 3.91. There is little doubt that among secondary mathematics teachers the use of teacher-prepared tests is the most important evaluation technique in the list. The greatest difference in the average ranking on an item between the elementary and secondary teachers was nearly one and one-half points on a five-point scale for utilization of teacher-prepared checklists.

5.8 Other Resources

5.8.1 Elementary Teachers

There were three additional items on the questionnaire concerning resources helpful to classroom instruction. The three items were intended to gather data concerning the existence of Learning Assistance Centres for Mathematics, resource persons at the school or district level, and locally developed mathematics programmes.

Table 5-27
Elementary Teachers:
Existence of Learning Assistance Centre for Mathematics (percent)

	Grade 1	Grade 3	Grade 5	Grade 7
Yes*	36.8	40.4	47.6	47.9

* indicates a significant difference at the 0.05 level among the respondent groups.

The statistically significant difference appears to be caused by the higher positive response rate of the intermediate teachers. Overall, nine percent more intermediate teachers than primary teachers responded that they did have a Learning Assistance Centre in their school that offered assistance in mathematics.

The differential response between the two levels is not as important as the overall response that only about forty-three percent of the elementary teachers said they had mathematics assistance available in their school from a Learning Assistance Centre. The situation becomes even more important when the data in Table 5-7, Section 5.4.1 are considered. All four groups of elementary teachers gave more learning assistance services a high rating.

Recommendation 5-4: Learning Assistance Centres for mathematics should be made more readily available in the schools of B.C.

The next item concerned the availability of resource persons for mathematics at both the district and school levels. These results are found in Table 5-28.

Overall, fifty-four percent of elementary teachers responded that there was a resource person for mathematics at the district level. Only twenty-two percent responded that there was a resource person for mathematics at the school level.

Table 5-28
Elementary Teachers:
Availability of Resource Personnel (Percent)

	Grade 1	Grade 3	Grade 5	Grade 7
District	56.2	55.7	53.9	50.1
School*	16.0	20.5	24.9	25.9

* indicates a significant difference at the 0.05 level among the respondent groups.

The data presented in Table 5-28 give some insight into the data presented earlier in Table 5-5, Section 5.3.1. The teachers ranked fifteen resources according to usefulness of each in the planning of lessons or units in mathematics. School district mathematics specialists and district supervisors received the two lowest ranks given by the teachers. The low rank may be due not to lack of quality work, but simply to the lack of availability to the teachers when needed. Over three-fourths of the elementary teachers responded that a mathematics resource person was not available in their school and almost half of the elementary teachers responded that a mathematics resource person was not available in their school district.

The final item in this section concerned the existence of mathematics programs designed by the teachers in their own schools to serve as a basis for mathematics instruction. The results for this item are found in Table 5-29.

Table 5-29
Elementary Teachers:
Existence of School Level Mathematics Program (Percent)

	Grade 1	Grade 3	Grade 5	Grade 7
Yes	15.8	15.1	14.7	15.8

The response rate was similar for all four grades with a positive response rate overall of about fifteen percent. About three elementary teachers out of every twenty responded that the teachers in their school had developed a mathematics program to serve as the basis for mathematics instruction in their school.

5.8.2 Secondary Teachers

Secondary teachers were asked to respond to the same three items as the elementary teachers concerning the existence of mathematics assistance from Learning Assistance Centres, resource personnel, and the existence of a school based mathematics program.

The first item dealt with the availability of mathematics assistance through Learning Assistance Centres. The results are presented in Table 5-30.

Table 5-30
Secondary Teachers:
Existence of Learning Assistance Centres for Mathematics (Percent)

	Grade 8	Grade 10	Grade 12
Yes	52.8	50.9	40.2

The positive response rate for secondary mathematics teachers was about fifty-one percent. It is probably more important that mathematics assistance be available at the lower grades and this seems to be the current situation. As with the elementary teachers, however, about half of the Grade 8 teachers responded that mathematics assistance through Learning Assistance Centres is not available. The situation becomes even more important at the Grade 8 level when the data in Table 5-8, Section 5.4.2 are considered. The Grade 8 teachers gave Learning Assistance services an above average rating on priorities based on the effect it has on their mathematics programs.

The next item also dealt with the availability of mathematics assistance. Secondary teachers of mathematics were asked to indicate whether or not a resource person was available to them at either the district or school level. The results are presented in Table 5-31.

Table 5-31
Secondary Teachers:
Availability of Resource Personnel (Percent)

	Grade 8	Grade 10	Grade 12
District*	35.1	19.5	19.8
School*	57.2	49.6	41.4

* indicates a significant difference at the 0.05 level among the respondent groups.

The overall percent of positive response for secondary mathematics teachers regarding availability of resource persons at the district level was about twenty-seven percent, and at the school level about fifty-two percent. This is the opposite pattern to the elementary teachers with fifty-four percent positive response at the district level and twenty-two percent at the school level. Combining both levels, the Grade 12 teachers seem to have the least availability of resource persons for mathematics.

The data presented in Table 5-31 give some insight into the data presented in Table 5-6, Section 5.3.2. When asked to rate fifteen resources according to their usefulness in planning lessons or units in mathematics, school district mathematics specialists and district supervisors were ranked lowest. The low rating may be due not to the lack of quality work, but to the lack of availability to the teachers when needed. Almost three-fourths of the secondary mathematics teachers responded that a mathematics resource person was not available at the district level and almost half the teachers responded that a mathematics resource person was not available at the school level.

Finally, secondary teachers of mathematics were asked to respond to the question "Does your school have a mathematics program designed by the teachers in your school as a basis for mathematics instruction?" The results for this item are presented in Table 5-32.

Table 5-32
Secondary Teachers:
Existence of a School Level Mathematics Program (Percent)

	Grade 8	Grade 10	Grade 12
Yes	57.2	64.6	61.8
No	42.8	35.4	38.2

The response rate was similar for all three groups with an overall rate of positive response of about sixty percent. The positive response rate for secondary mathematics teachers is four times the rate for elementary teachers. The fact that more secondary mathematics teachers develop their own programs to serve as a basis for mathematics instruction in their school than elementary teachers is as expected, since elementary teachers must cope with all the content areas, not only mathematics. That such a high percent of the secondary mathematics teachers expend the amount of time and effort it takes to develop such programs is certainly a sign of strength in the profession.

5.9 Homework in Secondary Mathematics

The final questionnaire item to be covered in this chapter appeared on the secondary form of the questionnaire only. The item dealt with how much out-of-class time secondary mathematics teachers felt students should spend on mathematics assignments. The results for the item are presented in Table 5-33.

Table 5-33
Secondary Teachers:
Amount of Time Students Require for Out-of-Class Assignments (Percent)

Time	Percent Responding: Grade 8	Grade 10	Grade 12
None	0.3	0.7	0.0
Less than 30 minutes per day	75.3	61.5	19.1
30-60 minutes per day	24.4	37.7	78.7
More than an hour per day	0.0	0.0	2.2

There is a definite shift in opinion as grade level increases. Grade 8 and 10 teachers feel that less than thirty minutes per day is the amount of out-of-class time students should spend on mathematics assignments with Grade 8 teachers selecting that choice in three to one ratio over thirty to sixty minutes per day. About seventy percent of the Grade 8 students (See Table 4-7, Section 4.2.7 of the Test Results report.) responded that they spend less than thirty minutes per day of out-of-class time on mathematics assignments. However, about fifteen percent of that group of students said they spent no out-of-class time at all on mathematics assignments.

When the Grade 8 students' data were organized by amount of time spent on mathematics homework (See Section 4.6.6 of the Test Results report.), the less-than-thirty-minutes group scored higher on all three domains. All three groups of secondary mathematics teachers indicated that giving no homework at all or assigning more than an hour per day are equally non-beneficial. The test results for the Grade 8 students tend to support the teachers. The same pattern of achievement held when Grade 12 data were organized by amount of time spent on mathematics homework.

5.10 Summary

Part IV of the Teacher Questionnaire contained thirteen items on the elementary form and sixteen items on the secondary form dealing with many facets of classroom instructional practices.

Of the five content areas listed, elementary teachers spent the most

time on drill on basic number facts and computation and the least time on geometry. Secondary mathematics teachers spent the most time on problem solving and applications and algebraic concepts and the least time on metric measurement. One other item on each form of the questionnaire gathered data concerning a specific content area, the metric system of measurement. With less than one calendar year left before the metric units are to be the predominant units used in the schools in all instruction, it was found that a majority of teachers are using both the metric and British units of measurement in their teaching.

All seven groups of teachers surveyed were asked to rate each item in a list of resources according to the usefulness of each in their planning day-to-day lessons or units in mathematics. All seven groups of teachers agreed that the students' textbook was a useful resource and the elementary teachers felt that the accompanying teachers' guidebook was useful. All seven groups also agreed that the least useful resources were school district mathematics specialists and supervisors.

In ranking sixteen factors purported to affect mathematics instruction, elementary teachers gave high priority to eight of the factors. The eight items can be organized into the following three groups: teaching load -- reduction of class size, reduction of total pupil load, greater release time for lesson preparation; materials -- more mathematics manipulative materials for individual classrooms, textbooks more suited to instructional needs, curriculum guides that outline content in specific terms, curriculum guides that offer more assistance in the instructional process; training -- more effective in-service and professional development. The secondary mathematics teachers gave high priority to each of the following four factors: reduction of class size, textbooks more suited to instructional needs, ability grouping of students for classes, and reduction of total pupil load.

Some very clear patterns were identified from the data gathered concerning the frequency of use of selected media, materials, and methods in the teaching of mathematics. Elementary teachers make frequent use of only one medium, the chalkboard, in presenting mathematics lessons. Though the overhead projector is making some inroads, the chalkboard is also the most popular medium for presenting secondary mathematics instruction. Although elementary teachers tend to make frequent use of many more different materials than secondary mathematics teachers, teacher-prepared materials head the list for all seven groups of teachers surveyed. Total class instruction and individualized instruction rank first and second in frequency of use of methods for presenting mathematics instruction for each of the seven groups of teachers surveyed. Those two methods were well ahead of any other method listed. Learning centres were used much more often by primary teachers than by any of the others.

All seven groups of teachers were in agreement that elementary students should not be allowed to use hand-held calculators and senior secondary students should be. If students are allowed to use hand-

held calculators, regardless of the grade level of the students, they should not be allowed unrestricted use and they should not be allowed to use hand-held calculators on tests. Students are allowed to use hand-held calculators to check work, to shorten computation time and effort in class work, and on non-test assignments. Hand-held calculators are also used to offer enrichment problems. The main use elementary teachers make of hand-held calculators is to show their students how to use hand-held calculators. Secondary mathematics teachers use hand-held calculators in their classes to shorten computation so that concepts may be covered in more depth and many more examples of the concept may be shown.

Over seventy percent of the secondary mathematics teachers responded that their school does not use a computer for instructional purposes. Another seventeen percent responded that their school uses a computer for instructional purposes, but that they do not use a computer in their mathematics class. The schools that do use computers for instructional purposes make use of the computer in many different classes. The teachers that use a computer in their mathematics classes seem to use it in similar fashion.

Teachers were asked to rate eight evaluation techniques, four teacher-prepared and four other-prepared, according to the importance they give to each. The elementary teachers rated each of the four teacher-prepared evaluation techniques well above any of the other-prepared ones. The secondary mathematics teachers rated teacher-prepared tests far above any other evaluation technique. Secondary mathematics teachers also attached importance to evaluating of performance on assignments and teacher observation of students' work.

Among the sources of mathematics assistance listed, a majority of the elementary teachers reported the availability of only one, the mathematics resource person at the district level. A very slight majority of the secondary mathematics teachers reported the availability of mathematics assistance from Learning Assistance Centres and mathematics resource personnel at the school level.

With respect to the existence of a mathematics program designed by the teachers of a school to serve as the basis for mathematics instruction for that school, only about fifteen percent of the elementary teachers reported the existence of such programs. A majority of the secondary mathematics teachers reported the existence of such programs.

The Grade 8 and 10 teachers agreed that students should spend less than thirty minutes per day of out-of-class time on mathematics assignments. The Grade 12 mathematics teachers felt the students should spend thirty to sixty minutes per day.

5.11 Summary of Recommendations

Recommendation 5-1: School districts should explore ways and means of making specialists' services more readily available and of more benefit to elementary teachers.

Recommendation 5-2: School districts should explore ways and means of making specialists' services more readily available and of more benefit to secondary teachers.

Recommendation 5-3: Teachers of mathematics at all levels should vary their teaching approaches to include such techniques as the use of learning centres and mathematics laboratory activities. Teacher educators should encourage their student teachers to develop the skills required to use such techniques.

Recommendation 5-4: Learning Assistance Centres for mathematics should be made more readily available in the schools of B.C.

CHAPTER 6

LEARNING OUTCOMES

One of the most important facets of mathematics instruction is what the teacher expects the students to be able to do once the instructional period is completed. Part II of the questionnaire contained items concerning the learning outcomes expected by the teachers of mathematics. All teachers, except the Grade 12 teachers, were asked to consider a list of learning outcomes for their specified grade level and to rate each item according to its importance in their view. Secondary teachers were also asked to rate a list of learning outcomes in order to determine which were important for entering Grade 8 students. All seven groups of teachers reacted to a list of learning outcomes with respect to their importance for a student upon completion of secondary school.

6.1 Relative Importance of Selected Curricular Objectives

Teachers at the Grades 1, 3, 5, 7, 8, and 10 levels were asked to rate each of a number of curricular objectives for their respective grades on a scale from 1, Not Important, to 5, Very Important. The results for each grade are discussed separately in the next six sub-sections.

Grade 12 teachers did not respond to such a question for two reasons. First, Grade 12 Mathematics is optional so no one list of learning outcomes would suffice for the many different mathematics courses offered, and second, all the teachers responded to a list of learning outcomes for secondary school graduation.

6.1.1 Grade 1 Teachers

Seven possible learning outcomes for a Grade 1 mathematics program were presented to the Grade 1 teachers. The results are in Table 6-1.

Table 6-1
Grade One Learning Outcomes

	Average Rating
Recall with reasonable speed and accuracy the addition, subtraction and multiplication facts to 10	4.53
Solve simple problems involving addition and subtraction	4.40
Recognize the role of zero in addition	4.29
Group by tens and ones and relate this to place value	4.14
Use the centimeter to measure and compare lengths	3.57
Classify geometric shapes	3.52
Relate multiplication to repeated addition using products to 10	3.10

The following four items had ratings higher than 4.0: recall with reasonable speed and accuracy subtraction and multiplication facts to 10; solve simple problems involving addition and subtraction; recognize the role of zero in addition; and group by tens and ones and relate this to place value. The two learning outcomes not related to computation received average ratings of about 3.5.

6.1.2 Grade 3 Teachers

The list of possible learning outcomes for a Grade 3 mathematics program contained sixteen items. The results are presented in Table 6-2.

Table 6-2
Grade Three Learning Outcomes

	Average Rating
Solve addition and subtraction examples with 2, 3, and 4 digit numerals, with and without regrouping	4.82
Solve multiplication examples for products to 50	4.71
Recall multiplication facts to 50	4.61
Understand the place value of numerals to 9999	4.54
Translate a word problem into mathematical symbols and solve using appropriate operations	4.39
Use expanded notation in renaming numbers to 9999	3.82
Read a thermometer in degrees Celsius	3.72
Estimate and measure length in metric units to kilometers	3.67
Estimate and measure capacity in millilitres and litres	3.43
Round off numbers to the nearest 10 or 100	3.41
Determine mass by balancing in grams and kilograms	3.27
Use graphs as a means of recording	3.23
Determine area by covering two dimensional spaces with centimeter squares	3.06
Construct simple geometric models of solid and plane shapes	2.88
Recognize axis of symmetry from experience with concrete materials	2.63
Read and write Roman numerals to 12	2.37

The Grade 3 teachers rated three items below 3.0 on the scale. Those items, in descending order, were: construct simple geometric models of solid and plane shapes; recognize axis of symmetry from experience with concrete materials; and read and write Roman numerals to 12. The first four of the five items with an average rating greater than 4.0 (the lowest was 4.39) were computation oriented. The five items, in descending order, were: solve addition and subtraction examples with 2, 3, and 4 digit numerals, with or without regrouping; solve multiplication examples for products to 50; recall multiplication facts to 50; understand the place value of numerals to 9999; and translate a word problem into mathematical symbols and solve using appropriate operations.

Grade 3 teachers gave high ratings to the computation oriented learning outcomes as did Grade 1 teachers. Six of the sixteen learning outcomes were classified as computation oriented. When the outcomes are placed in descending order based upon their average ratings, five of the first six are seen to be computation oriented. The first six are followed by three metric measurement outcomes and the final computation oriented learning outcome. The last six learning outcomes consist of two on metric measurement, three on geometry, and the one on Roman numerals.

6.1.3 Grade 5 Teachers

Seventeen possible learning outcomes for a Grade 5 mathematics program were rated by the Grade 5 teachers. The average rating for each is presented in Table 6-3.

The Grade 5 teachers rated three of the seventeen items as being below 3.0 in importance as learning outcomes for a Grade 5 mathematics program. The three items were: perform experiments involving translations, reflections, rotations, and flips; perform investigations and arrive at conclusions related to tiling (tessellations); and identify the circle and its parts. They rated eight of the items above 4.0. The eight items, in descending order, were: recall basic number facts; indicate the place value of each digit of a numeral in standard notation; use the division algorithm with whole numbers; use the addition algorithm with whole numbers, common fractions, and decimal fractions (to 100ths); use the subtraction algorithm with whole numbers, common fractions, and decimal fractions (to 100ths); construct and solve word problems arising out of investigations; use the multiplication algorithm with whole numbers, common fractions, and decimal fractions (to whole number X 1000ths); and use instruments to measure length, area, volume, capacity, mass, and temperature in metric units.

Following the same pattern set by the Grade 1 and 3 teachers, Grade 5 teachers gave the highest ratings to computation oriented learning outcomes. When the list of outcomes is placed in descending order, as in Table 6-3, the top five items are computation oriented

and the last four are not.

Table 6-3
Grade Five Learning Outcomes

	Average Rating
Recall basic number facts	4.87
Indicate place value of each digit of a numeral in standard notation	4.52
Use the division algorithm with whole numbers	4.51
Use the addition algorithm with whole numbers, common fractions, and decimal fractions (the 100ths)	4.39
Use the subtraction algorithm with whole numbers, common fractions, and decimal fractions (the 100ths)	4.37
Construct and solve word problems arising out of investigations	4.21
Use the multiplication algorithm with whole numbers, common fractions, and decimal fractions (to whole number X 1000ths)	4.16
Use instruments to measure length, area, volume, capacity, mass, and temperature in metric units	4.08
Regroup as required for algorithms	3.73
Interpret graphs	3.71
Express a number as the product of its prime factors	3.54
Construct graphs	3.44
Write numbers in expanded form	3.42
Identify and list properties of common three dimensional geometrical forms	3.06
Identify the circle and its parts	2.89
Perform experiments involving translations, reflections, rotations, and flips	2.11
Perform investigations and arrive at conclusions related to tiling (tessellations)	2.11

6.1.4 Grade 7 Teachers

The longest list of learning outcomes for the elementary grades was presented to the Grade 7 teachers and it contained twenty-one items to be rated according to each one's importance in a Grade 7 mathematics program. The results are presented in Table 6-4.

Table 6-4
Grade Seven Learning Outcomes

	Average Rating
Perform the operations of addition, subtraction, multiplication and division with whole numbers, common fractions, and decimal fractions	4.88
Perform in the correct order, a calculation involving more than one of the four basic operations	4.50
State the value represented by each digit in a multi-digit decimal numeral	4.48
Solve simple open sentences	4.40
Test the appropriateness of an answer to a problem	4.38
Write a percent numeral for a fraction numeral or a decimal numeral	4.27
Solve problems involving percent	4.27
Write a decimal numeral for a fraction numeral and vice versa	4.26
Use instruments to measure length, area, volume, capacity, mass, and temperature in metric units	4.25
Translate word problems into open sentences	4.22
Write sets of equivalent fractions	3.98
Calculate perimeters of rectangles and triangles	3.84
Draw or interpret scale diagrams	3.64
Calculate the lowest common multiple (LCM) of two or more whole numbers	3.59
Calculate the greatest common factor (GCF) of two or more whole numbers	3.53
Write a whole number as a product of its prime factors	3.40
Use a compass and straight-edge to copy an angle	3.27
Construct a flow chart to fit a verbal description of an operation or procedure	3.21
Write a decimal numeral in expanded form using powers of 10 in exponent form	3.20
Identify from a diagram, or draw a diagram, illustrating acute, right and obtuse angles	3.17
Use a compass and straight-edge to bisect an angle	3.12

The Grade 7 teachers ranked ten of the twenty-one learning outcomes above 4.0, the lowest of these being 4.22. The ten learning outcomes, in descending order, were: perform the four basic operations with whole numbers, fractions, and decimals; perform, in the correct order, a calculation involving more than one of the four basic operations; state the value represented by each digit in a multi-digit decimal numeral; solve simple open sentences; test the appropriateness of an answer to a problem; solve problems involving percent; write a percent numeral for a fraction numeral or a decimal numeral; write a decimal numeral for a fraction numeral and vice versa; use instruments to measure length, area, volume, capacity, mass, and temperature in metric units; and translate word problems into open sentences. All twenty-one of the learning outcomes listed for a Grade 7 mathematics program were also presented to the secondary mathematics teachers. The secondary teachers were asked to rank each item according to its importance for an entering Grade 8 student. Those results are presented in Section 6.2.2.

6.1.5 Grade 8 Teachers

As with the elementary teachers, the Grade 8 and 10 mathematics teachers were asked to respond to a list of learning outcomes for their particular grade level. There were twenty-three learning outcomes presented to the Grade 8 mathematics teachers. The data are summarized in Table 6-5.

The computational learning outcomes tend to be grouped into larger outcomes for the Grade 8 list. Of the twenty-three learning outcomes listed for Grade 8, only three deal specifically with performing computation. All three, however, were ranked among the top five learning outcomes. The Grade 8 mathematics teachers ranked ten of the learning outcomes higher than 4.0. The ten outcomes, in descending order, were: perform the four basic operations with whole numbers, common fractions, and decimal fractions; perform the four basic operations with integers; write a decimal numeral, fraction numeral and percent numeral for any number given in one of the three forms; solve problems involving percent; perform, in conventional order, a calculation involving a series of operations; state the value represented by each digit in a multi-digit decimal; solve open sentences; test the appropriateness of an answer to a problem; translate verbal problems into open sentences; and calculate perimeters and areas of circles, rectangles, and triangles. Grade 8 is the lowest grade level of those surveyed that ranked a geometry learning outcome greater than 4.0.

The use of set notation and constructing a flow chart to fit a verbal description were the only two learning outcomes that were ranked below the mid-point on the scale.

Table 6-5
Grade Eight Learning Outcomes

	Average Rating
Perform the four basic operations with whole numbers, common fractions, and decimal fractions	4.93
Perform the four basic operations with integers	4.72
Write a decimal numeral, fraction numeral and percent numeral for any number given in one of the three forms	4.56
Solve problems involving percent	4.44
Perform, in conventional order, a calculation involving a series of operations	4.43
State the value represented by each digit in a multi-digit decimal numeral	4.39
Solve simple open sentences	4.39
Test the appropriateness of an answer to a problem	4.32
Translate verbal problems into open sentences	4.15
Calculate perimeters and areas of circles, rectangles, and triangles	4.11
Round a decimal numeral to a specified place value	3.98
Use the Pythagorean Theorem to calculate a side of a right triangle	3.60
Calculate the LCM of two or more numbers	3.50
Calculate the GCF of two or more numbers	3.45
Write a whole number as a product of its prime factors	3.41
Use a compass and straight-edge to bisect an angle and bisect a line segment	3.36
Use a table to find the approximate square root of a number	3.35
Write decimal numerals in expanded form using powers of ten in exponent form	3.30
Draw or interpret scale drawings	3.24
Use a compass and straight-edge to construct a perpendicular to a line from a point not on the line and a parallel to a line through a given point	3.19
Write decimal numerals in scientific notation	3.12
Construct a flow chart to fit a verbal description	2.72
Use of set notation	2.66

Of the twenty-one learning outcomes listed for a Grade 7 mathematics program and the twenty-three listed for Grade 8, fourteen were common to both grade levels. The results on the common items in Tables 6-4 and 6-5 reveal that the Grade 7 and 8 teachers gave similar ratings to these learning outcomes. On ten of the fourteen learning outcomes the two averages differ by one-tenth of a point or less. On the other four, the Grade 7 teachers ranked two items higher and two items lower than their Grade 8 counterparts.

6.1.6 Grade 10 Teachers

Grade 10 teachers were presented a list of twenty-three learning outcomes, but only three were taken from the Grade 8 list. The data for the Grade 10 teachers are summarized in Table 6-6.

Grade 10 teachers rated nine of the twenty-three learning outcomes higher than 4.0. Those nine learning outcomes, in descending order, were: perform the four basic operations with whole numbers, common fractions, and decimal fractions; perform the four basic operations with integers; write a decimal numeral, fraction numeral and percent numeral for any number given in one of the three forms; solve word problems algebraically; calculate one side of a right-angled triangle given the other two sides; solve problems involving simple interest; add and multiply polynomials; solve systems of linear equations; given an equation in two variables, graph the equation in the coordinate plane. Again, the computation learning outcomes are ranked at the head of the list, but the nine highly ranked items include two geometry learning outcomes and three algebra learning outcomes. The first three items in Table 6-6 were also listed as learning outcomes for Grade 8. The Grade 8 and 10 teachers ranked all three learning outcomes very highly. The lowest rating obtained for any of the common items by either group was 4.48.

The Grade 10 teachers ranked three of the learning outcomes below 3.0 on the scale: explain the nature of annuities; calculate the resultant vector for two given vectors by a scale drawing; and use elementary BASIC as a programming language to write, execute, and debug simple programs.

Table 6-6
Grade Ten Learning Outcomes

	Average Rating
Perform the four basic operations with whole numbers, common fractions, decimal fractions	4.75
Perform the four basic operations with integers	4.65
Write a decimal numeral, fraction numeral, and percent numeral for any number given in one of the three forms	4.48
Solve word problems algebraically	4.35
Calculate one side of a right-angled triangle given the other two sides	4.26
Solve problems involving simple interest	4.11
Add and multiply polynomials	4.06
Solve systems of linear equations	4.06
Given an equation in variables, graph the equation in the coordinate plane	4.06
Use the laws of exponents in simplifying expressions with integral exponents	3.90
Write the square of any binomial as a trinomial	3.82
Factor a quadratic trinomial	3.81
Explain the meaning of compound interest	3.80
Determine whether two triangles are similar	3.71
Divide a given polynomial by a (linear) binomial	3.48
Specify the sine, cosine, and tangent of an acute angle as the ratio of two sides of a right triangle	3.45
Calculate products and quotients using scientific notation	3.42
Calculate the true rate of interest in installment payments when given the formula	3.42
Use the axioms of the real numbers	3.29
Distinguish between rational and irrational numbers by their decimal form	3.25
Explain the nature of annuities	2.96
Calculate the resultant vector for two given vectors by a scale diagram	2.73
Use elementary BASIC as a programming language to write, execute, and debug simple programs	

6.2 Minimal Objectives for Mathematics

6.2.1 Secondary School Leaving Objectives

A list of twelve learning outcomes for graduation from secondary school was presented to all seven groups of teachers. They were asked to rank the learning outcomes according to their importance. The scale used for the ranking had three points: Optional; Important, but not essential; and Essential. The data for each group of teachers on each learning outcome are summarized in this section. The average rankings were computed using the weights shown in Figure 6-1.

Response	Weight
Optional	1
Important, but not essential	2
Essential	3

Response Scores

Figure 6-1: Weights for Ratings of Learning Outcomes

All seven groups were also asked at which grade level they felt students should be required to take a mathematics course. The percent of positive response for each grade level from each group of teachers is also presented.

Elementary Teachers

The average rating for each of the twelve learning outcomes from the four groups of elementary teachers is presented in Table 6-7.

Over ninety-eight percent of the elementary teachers felt that it was essential that a secondary school graduate be able to accurately perform the four basic operations with whole numbers. Only about sixty-three percent of them felt it was essential that graduates be able to compute with common fractions, though about thirty-four percent more felt it was important, but not essential. About seventy-seven percent of the elementary teachers felt that the ability to compute with decimal fractions was essential. Substantially fewer held this opinion about computing with common fractions.

Three other learning outcomes were marked as essential by a large majority of the elementary teachers. Ninety-three percent of the elementary teachers felt that graduates should be able to use the metric units of measurement. The elementary teachers also felt it essential that graduates should be able to apply their mathematical knowledge to physical world situations, seventy-five percent, and to

Table 6-7
Elementary Teachers: Learning Outcomes for Graduation from Secondary School

	Grade 1	Grade 3	Grade 5	Grade 7
Accurately perform the four basic operations with whole numbers	2.97	3.00	2.98	2.98
Accurately perform the four basic operations with common fractions	2.57	2.60	2.57	2.63
Accurately perform the four basic operations with decimal fractions	*2.62	2.69	2.76	2.89
Use the "basic" formulas for area and volume	*2.29	2.44	2.45	2.48
Use the Pythagorean Theorem	1.64	1.68	1.69	1.61
Solve linear equations	*1.99	2.10	2.12	2.17
Solve quadratic equations	1.68	1.72	1.70	1.69
Use the metric units of measurement	2.91	2.92	2.93	2.93
Evaluate the given algebraic expression	*1.83	1.91	1.92	2.00
Recognize and name geometric figures	*2.37	2.33	2.26	2.17
Apply mathematical knowledge to physical world situations	2.71	2.78	2.71	2.75
Apply mathematical knowledge to consumer related situations	2.87	2.92	2.87	2.89

* indicates a significant difference at the 0.05 level among respondent groups.

consumer related situations, ninety percent.

Forty-three percent of the elementary teachers felt that use of the Pythagorean Theorem should be an optional learning outcome and forty-one percent felt that solving quadratic equations should be optional.

In Table 6-8 the results for the item dealing with the grade levels at which students should be required to take either an academic or non-academic mathematics course are presented. The data in Table 6-8 are the percent of the teachers giving a positive response to the specified grade.

Currently in B.C., mathematics is required in Grades 8, 9, 10 for graduation, while mathematics in Grades 11 and 12 is optional. Almost ninety-nine percent of the elementary teachers felt that a mathematics course should continue to be required in Grades 8-10. Over eighty-four percent of them felt that a mathematics course should be required at the Grade 11 level and over seventy-three percent felt that a mathematics course should be required in Grade 12. It is

interesting to note that there are no statistically significant differences among the data in Table 6-8. All four groups had similar opinions regarding the requirement of a mathematics course at each of the grades listed.

Table 6-8
Elementary Teachers: Grade Levels of Required Mathematics Courses

	Grade 1	Grade 3	Grade 5	Grade 7
Grade 8	100.0	99.8	99.6	100.0
Grade 9	99.5	99.1	99.1	99.8
Grade 10	99.1	96.8	97.1	97.3
Grade 11	87.1	84.2	83.3	82.7
Grade 12	76.1	73.2	71.3	71.9

Secondary Teachers

The average ranking for each of the twelve learning outcomes from the three groups of secondary mathematics teachers is presented in Table 6-9.

All but four of the 744 secondary mathematics teachers responding felt that it was essential that a secondary school graduate be able to accurately perform the four basic operations with whole numbers. This rate does not drop much for fractions and decimals. Over ninety-three percent of the secondary mathematics teachers felt the ability to compute with common fractions was essential for graduates; over ninety-seven percent felt that the ability to compute with decimal fractions was also essential.

Eighty-nine percent of the teachers felt it was essential for graduates to use the metric units of measurement. Graduates being able to use the "basic" formulas for area and volume was felt to be essential by seventy-five percent of the respondents. The teachers also felt that it was essential that graduates be able to apply the mathemtical knowledge to physical world situations, seventy-six percent, and consumer related situations, eighty-seven percent.

Solving quadratic equations was the learning outcome with the lowest average. Almost thirty-five percent of the secondary mathematics teachers responded that solving quadratic equations should be an optional learning outcome.

Table 6-9
Secondary Teachers: Learning Outcomes for Graduation from Secondary School

	Grade 8	Grade 10	Grade 12
Accurately perform the four basic operations with whole numbers	*3.00	3.00	2.97
Accurately perform the four basic operations with common fractions	2.92	2.94	2.93
Accurately perform the four basic operations with decimal fractions	2.98	2.97	2.94
Use the "basic" formulas for area and volume	2.76	2.72	2.62
Use the Pythagorean Theorem	2.25	2.25	2.28
Solve linear equations	2.37	2.25	2.39
Solve quadratic equations	1.79	1.80	1.92
Use the metric units of measurement	*2.92	2.75	2.88
Evaluate a given algebraic expression	2.32	2.23	2.30
Recognize and name geometric figures	2.39	2.40	2.28
Apply mathematical knowledge to physical world situations	2.77	2.73	2.67
Apply mathematical knowledge to consumer related situations	*2.90	2.85	2.80

* indicates a significant difference at the 0.05 level among respondent groups.

A comparison of the data in Tables 6-7 and 6-9 reveals several interesting patterns. Secondary mathematics teachers ranked ten of the twelve learning outcomes higher than did the elementary teachers. All the groups were in agreement on computation with whole numbers, use of the metric units of measurement, and both situations concerning application of mathematical knowledge. The greatest difference between the averages of the elementary teachers and secondary mathematics teachers was on the use of the Pythagorean Theorem. There were also sizeable differences, ranging from 0.31 to 0.37 on the three-point scale, between the averages of the elementary teachers and the secondary mathematics teachers on the importance of graduating with the ability to evaluate an algebraic expression, compute with common fractions, and use the basic formulas for area and volume.

In Table 6-10 the secondary mathematics teachers' results for the item dealing with the grade levels at which students should be required to take either an academic or non-academic mathematics course are presented. The data in Table 6-8 are the percent of the

teachers giving a positive response for the specified grade.

Table 6-10
Secondary Teachers: Grade Levels of Required Mathematics Courses

	Grade 8	Grade 10	Grade 12
Grade 8	99.5	99.6	100.0
Grade 9	* 99.7	97.4	98.9
Grade 10	97.6	94.9	94.4
Grade 11	* 79.0	80.3	65.9
Grade 12	* 54.3	43.7	31.0

* indicates a significant difference at the 0.05 level among respondent groups.

Over ninety-eight percent of the secondary mathematics teachers felt that a mathematics course should continue to be required in Grades 8, 9, and 10. The level of positive response for Grade 11, while lower, still represents about seventy-eight percent of the secondary mathematics teachers. Significantly fewer Grade 12 mathematics teachers than Grades 8 and 10 wanted to extend the required mathematics courses into Grade 11. The level of positive response dropped below fifty percent for Grade 12. A majority of the secondary mathematics teachers did not want a required mathematics course in Grade 12. Two out of every three Grade 12 mathematics teachers wanted the optional status of the mathematics courses in Grade 12 to remain.

A comparison of the data for elementary teachers and secondary mathematics teachers shows that on the first three grade levels, both groups feel very strongly that the requirement of a mathematics course should continue. About six percent more elementary teachers than secondary mathematics teachers were in favour of a required mathematics course in Grade 11. The most significant difference, however, occurs at the Grade 12 level with over twenty-five percent more elementary teachers than secondary mathematics teachers wanting a required mathematics course at the Grade 12 level. The elementary teachers were in favour of a required mathematics course at the Grade 12 level by almost a three-to-one margin; a majority of the secondary mathematics teachers did not want a required mathematics course at the Grade 12 level.

6.2.2 Elementary School Leaving Objectives

Just as the elementary teachers were asked to react to a list

of learning outcomes for graduation from secondary school, secondary mathematics teachers were asked to react to a list of learning outcomes for completion of elementary school. They were asked to rank each of twenty-one learning outcomes on a scale with three points: Optional; Important, but not essential; and Essential. The average ratings, presented in Table 6-11, were computed using the weighting scheme shown in Figure 6-1.

Of the eight statistically significant differences, half were caused by the Grade 8 teachers ranking the item significantly lower than the Grade 10 and 12 teachers.

Dividing up the three-point scale and looking at the data in Table 6-11 shows that no learning outcomes had averages between 1.0 and 1.5, six were between 1.5 and 2.0, eight were between 2.0 and 2.5, and seven were between 2.5 and 3.0.

The following seven items, listed in descending order, had an overall average greater than 2.5 on the three-point scale: perform the four basic operations with whole numbers, fractions, and decimals; state the value represented by each digit in a multi-digit decimal numeral; perform, in the correct order, a calculation involving more than one of the four basic operations; write sets of equivalent fractions; write a decimal numeral for a fraction numeral and vice versa; test the appropriateness of an answer to a problem; and write a percent numeral for a fraction numeral or decimal numeral.

Since there were no learning outcomes that averaged between 1.0 and 1.5, it cannot be said that any of the learning outcomes had averages that were very low. The lowest ranked learning outcome - construct a flow chart to fit a verbal description - had an average ranking of 1.55.

The learning outcomes listed in Table 6-11 are identical to those listed in Table 6-4, which dealt with the possible learning outcomes of a Grade 7 mathematics program. The Grade 7 teachers, however, were ranking each learning outcome on a scale from 1, Not Important, to 5, Very Important. The only comparison which can be made of the data in the two tables is to compare those learning outcomes that were ranked relatively high in both tables. The Grade 7 teachers ranked ten items greater than 4.0 on the five-point scale. Of the ten highest ranked items by the secondary mathematics teachers, eight are in the Grade 7 teachers' top ten list. The two items that appeared on the top ten list for the Grade 7 teachers, but not the secondary mathematics teachers were ranked eleventh and fourteenth by the secondary mathematics teachers. Analogously, the Grade 7 teachers ranked items eleventh and twelfth that were on the secondary mathematics teachers' top ten list. It appears that the Grade 7 teachers and the secondary mathematics teachers have similar opinions concerning the important learning outcomes for the elementary mathematics program.

Table 6-11
Secondary Teachers: Learning Outcomes for an Elementary Mathematics Program

	Grade 8	Grade 10	Grade 12
State the value represented by each digit in a multi-digit decimal numeral	2.83	2.85	2.80
Write a decimal numeral in expanded form using powers of 10 in exponent form	*1.77	1.95	2.01
Perform in the correct order, a calculation involving more than one of the four basic operations	2.65	2.72	2.76
Perform the operations of addition, subtraction, multiplication, and division with whole numbers, common fractions, and decimal fractions	2.96	2.95	2.97
Write a whole number as a product of its prime factors	*2.01	2.30	2.35
Calculate the greatest common factor (GCF) of two or more whole numbers	*2.00	2.24	2.15
Calculate the least common multiple (LCM) of two or more whole numbers	*2.08	2.30	2.26
Write sets of equivalent fractions	2.66	2.77	2.64
Write a decimal numeral for a fraction numeral and vice versa	2.64	2.72	2.74
Write a percent numeral for a fraction numeral or decimal numeral	*2.49	2.62	2.65
Solve simple open sentences	*2.10	2.25	2.38
Use a compass and straight-edge to copy an angle	*1.64	1.86	1.74
Use a compass and straight-edge to bisect an angle	*1.60	1.77	1.65
Identify from a diagram, or draw a diagram illustrating acute, right, and obtuse angles	1.80	1.91	1.94
Use instruments to measure length, area, volume, capacity, mass, and temperature in metric units	2.39	2.42	2.42
Translate word problems into open sentences	2.07	2.10	2.21
Construct a flow chart to fit a verbal description	1.56	1.51	1.61
Test the appropriateness of an answer to a problem	2.56	2.63	2.65
Draw or interpret scale diagrams	1.73	1.79	1.88
Solve problems involving percents	2.30	2.35	2.49
Calculate perimeters of rectangles and triangles	2.31	2.41	2.49

* indicates a significant difference at the 0.05 level among respondent groups.

6.3 Summary

Six of the seven groups of teachers were presented lists of possible mathematics learning outcomes for their specified grades. The teachers were asked to rate each learning outcome on a scale from 1, Not Important, to 5, Very Important. Relative to the five-point scale, only about ten percent of the learning outcomes were given below average rankings. As expected, the computation-oriented learning outcomes were given high rankings. All the Grade 3 learning outcomes that were ranked greater than 4.0 were computation-oriented. The geometry learning outcomes were given relatively low rankings by all groups of elementary teachers. The order of operations learning outcome on Grade 7 was ranked second out of twenty-one learning outcomes, but the order of operations item on the Grade 8 Mathematics Assessment test yielded the lowest performance on the test. The learning outcomes that were common to Grades 7 and 8 were given similar rankings, in most cases, by both groups of teachers. The final grade, Grade 10, followed the pattern that had been set by all the preceding groups by giving the computation-oriented learning outcomes high rankings. The Grade 10 mathematics teachers also gave high ratings to two geometry and three algebra learning outcomes.

The results concerning minimal mathematics objectives for graduation from secondary school showed very clear patterns. All seven groups of teachers put a high premium on graduates being able to perform the four basic operations with whole numbers, fractions, and decimals. All seven groups of teachers also felt it is essential that graduates be able to apply their mathematical knowledge in both physical world and consumer related situations. All teachers agreed that it is essential that graduates be able to use the metric units of measurement. The differences of opinion between elementary teachers and secondary mathematics teachers appeared to be over the more technical aspects of mathematics. The two groups disagreed on the relative importance of a graduate being able to use the Pythagorean Theorem, to evaluate an algebraic expression, and to use the basic formulas for area and volume.

All teachers surveyed were in agreement that mathematics courses for Grades 8, 9, and 10 should continue to be required. Elementary teachers reacted slightly more strongly than the secondary mathematics teachers that there should be a required mathematics course for Grade 11. Elementary teachers responded that they wanted a required mathematics course in Grade 12 by almost a three-to-one margin. Less than fifty percent of the secondary mathematics teachers wanted such a course.

APPENDIX A

QUESTIONNAIRE FOR ELEMENTARY TEACHERS

(1) (2) (3) (4) (5)
SCHOOL CODE

BRITISH COLUMBIA LEARNING ASSESSMENT PROGRAM

ELEMENTARY MATHEMATICS

A TEACHER QUESTIONNAIRE

We appreciate the fact that school programs at the present time are so varied that the questions posed here may not fit your school organization or philosophy. Where there is a lack of 'fit' between our questions and your organization or philosophy, please specify and comment. Use the last page for more detailed comment. In general, we would ask that you respond as fully as you can.

IMPORTANT

ON THE LABEL ON THE ENVELOPE IN WHICH YOU RECEIVED THIS QUESTIONNAIRE IS MARKED A GRADE/YEAR LEVEL CORRESPONDING TO ONE OF THOSE BELOW. PLEASE CHECK THE APPROPRIATE BOX AND RESPOND TO THE QUESTIONNAIRE WITH THIS ONE GRADE LEVEL IN MIND, EVEN THOUGH YOU MAY ALSO TEACH OTHER LEVELS.

Grade/Year 1 ---------- ☐ 1
Grade/Year 3 ---------- ☐ 2
Grade/Year 5 ---------- ☐ 3
Grade/Year 7 ---------- ☐ 4 (8)

ON SOME ITEMS, MORE THAN ONE CHOICE MAY BE MARKED. SUCH ITEMS WILL BE PRECEDED BY '(MULTIPLE RESPONSE ITEM)'.

PLEASE DO NOT USE THIS SPACE

PART I

BACKGROUND AND GENERAL INFORMATION

CHECK THE APPROPRIATE CATEGORY:

1. YEARS OF POST-SECONDARY EDUCATION AS OF JUNE, 1977:

1	☐ 1	
2	☐ 2	
3	☐ 3	
4	☐ 4	
5	☐ 5	
6 or more	☐ 6	(9)

2. YEARS OF TEACHING EXPERIENCE AS OF JUNE, 1977:

1 or less	☐ 1	
2 - 5	☐ 2	
6 - 9	☐ 3	
10 - 13	☐ 4	
14 or more	☐ 5	(10)

3. (MULTIPLE RESPONSE ITEM) AT WHICH OF THE FOLLOWING LEVELS HAVE YOU TAUGHT?

Primary	☐ 1	(11)
Intermediate	☐ 1	(12)
Junior Secondary	☐ 1	(13)
Senior Secondary	☐ 1	(14)

4. IN YOUR UNDERGRADUATE TRAINING, WAS/IS MATHEMATICS ONE OF YOUR MAJOR SUBJECT AREAS?

Yes	☐ 1	
No	☐ 2	(15)

135

5. HAVE YOU COMPLETED AT LEAST ONE COURSE IN MATHEMATICS CONTENT BEYOND SECONDARY GRADUATION?

Yes	☐	1
No	☐	2 (16)

6. HAVE YOU COMPLETED AT LEAST ONE COURSE IN HOW TO TEACH MATHEMATICS (MATHEMATICS METHODS COURSE)?

Yes, more than 10 years ago	☐	1
Yes, in the last 10 years	☐	2
No	☐	3 (17)

7. (MULTIPLE RESPONSE ITEM) TO WHICH OF THE FOLLOWING ASSOCIATIONS DO YOU CURRENTLY BELONG?

B.C. Association of Mathematics Teachers	☐	1 (18)
Provincial Intermediate Teachers Association	☐	1 (19)
B.C. Primary Teachers Association	☐	1 (20)
National Council of Teachers of Mathematics	☐	1 (21)
Local Mathematics P.S.A.	☐	1 (22)

8. HAVE YOU ATTENDED A MATHEMATICS SESSION AT A CONFERENCE IN THE LAST THREE YEARS?

Yes	☐	1
No	☐	2 (23)

9. HAVE YOU ATTENDED A WORKSHOP (OTHER THAN AT A CONFERENCE) OR IN-SERVICE DAY IN MATHEMATICS IN THE LAST THREE YEARS?

Yes	☐	1
No	☐	2 (24)

10. PLEASE MARK EACH OF THE FOLLOWING STATEMENTS ACCORDING TO HOW STRONGLY YOU AGREE OR DISAGREE WITH EACH:

	Strongly Agree				Strongly disagree	
a) Mathematics was one of my favourite subjects as a student in College or University.	5	4	3	2	1	(25)
b) Mathematics is one of my favourite subjects to teach.	5	4	3	2	1	(26)
c) Mathematics is one of the easiest subjects for me to teach.	5	4	3	2	1	(27)

136

11. PLEASE RATE EACH OF THE FOLLOWING SUBJECT AREAS INDIVIDUALLY ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR THE STUDENT'S SUCCESS IN SCHOOL:

	Very Important				Not Important	
a. Art	5	4	3	2	1	(28)
b. Language Arts	5	4	3	2	1	(29)
c. Mathematics	5	4	3	2	1	(30)
d. Music	5	4	3	2	1	(31)
e. Physical Education	5	4	3	2	1	(32)
f. Reading	5	4	3	2	1	(33)
g. Science	5	4	3	2	1	(34)
h. Social Studies	5	4	3	2	1	(35)

12. PLEASE RATE EACH OF THE FOLLOWING SUBJECT AREAS INDIVIDUALLY ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR THE STUDENT'S ADULT LIFE:

	Very Important				Not Important	
a. Art	5	4	3	2	1	(36)
b. Language Arts	5	4	3	2	1	(37)
c. Mathematics	5	4	3	2	1	(38)
d. Music	5	4	3	2	1	(39)
e. Physical Education	5	4	3	2	1	(40)
f. Reading	5	4	3	2	1	(41)
g. Science	5	4	3	2	1	(42)
h. Social Studies	5	4	3	2	1	(43)

137

PART II

LEARNING OUTCOMES

ITEM 13 HAS FOUR PARTS. PLEASE RESPOND TO THE ONE PART THAT IS CONCERNED WITH THE GRADE/YEAR LEVEL MARKED ON THE COVER PAGE.

13 A IS FOR GRADE 1 TEACHERS	13 B IS FOR GRADE 3 TEACHERS
13 C IS FOR GRADE 5 TEACHERS	13 D IS FOR GRADE 7 TEACHERS

13 A. IN THE LIST BELOW ARE SOME OF THE LEARNING OUTCOMES ONE MIGHT HAVE FOR A GRADE 1 MATHEMATICS PROGRAM. USING THE SCALE PROVIDED, PLEASE MARK THE ITEMS ACCORDING TO THE IMPORTANCE YOU GIVE EACH.

THE TOTAL GRADE 1 MATHEMATICS PROGRAM SHOULD PREPARE THE CHILD SO THAT HE/SHE IS ABLE TO:

	Very Important				Not Important	
a. Recall with reasonable speed and accuracy the addition, subtraction, and multiplication facts to 10	5	4	3	2	1	(44)
b. Recognize the role of zero in addition	5	4	3	2	1	(45)
c. Relate multiplication to repeated addition using products to 10	5	4	3	2	1	(46)
d. Solve simple problems involving addition and subtraction	5	4	3	2	1	(47)
e. Group by tens and ones and relate this to place value	5	4	3	2	1	(48)
f. Classify geometric shapes	5	4	3	2	1	(49)
g. Use the centimetre to measure and compare lengths	5	4	3	2	1	(50)

13 B. IN THE LIST BELOW ARE SOME OF THE LEARNING OUTCOMES ONE MIGHT HAVE FOR A GRADE 3 MATHEMATICS PROGRAM. PLEASE MARK THE ITEMS ACCORDING TO THE IMPORTANCE YOU GIVE EACH.

THE TOTAL GRADE 3 MATHEMATICS PROGRAM SHOULD PREPARE THE CHILD SO THAT HE/SHE IS ABLE TO:

	Very Important				Not Important	
a. Use expanded notation in renaming numbers to 9999	5	4	3	2	1	(51)
b. Round off numbers to the nearest 10 or 100	5	4	3	2	1	(52)
c. Understand the place value of numerals to 9999	5	4	3	2	1	(53)
d. Read and write Roman numerals to 12	5	4	3	2	1	(54)
e. Solve addition and subtraction examples with 2, 3 and 4 digit numerals, with and without re-grouping	5	4	3	2	1	(55)
f. Solve multiplication examples for products to 50	5	4	3	2	1	(56)
g. Recall multiplication facts to 50	5	4	3	2	1	(57)
h. Construct simple geometric models of solid and plane shapes	5	4	3	2	1	(58)
i. Translate a word problem into mathematical symbols and solve using appropriate operations	5	4	3	2	1	(59)
j. Recognize axis of symmetry from experience with concrete materials	5	4	3	2	1	(60)
k. Use graphs as a means of recording	5	4	3	2	1	(61)
l. Estimate and measure capacity in millilitres and litres	5	4	3	2	1	(62)
m. Estimate and measure length in metric units to kilometres	5	4	3	2	1	(63)
n. Determine mass by balancing in grams and kilograms	5	4	3	2	1	(64)
o. Determine area by covering two dimensional spaces with centimetre squares	5	4	3	2	1	(65)
p. Read a thermometer in degrees Celsius	5	4	3	2	1	(66)

13 C. IN THE LIST BELOW ARE SOME OF THE LEARNING OUTCOMES ONE MIGHT HAVE FOR A GRADE 5 MATHEMATICS PROGRAM. PLEASE MARK THE ITEMS ACCORDING TO THE IMPORTANCE YOU GIVE EACH.

THE TOTAL GRADE 5 MATHEMATICS PROGRAM SHOULD PREPARE THE CHILD SO THAT HE/SHE IS ABLE TO:

		Very Important				Not Important	
a.	Recall basic number facts	5	4	3	2	1	(67)
b.	Indicate place value of each digit of a numeral in standard notation	5	4	3	2	1	(68)
c.	Write numbers in expanded notation	5	4	3	2	1	(69)
d.	Regroup as required for algorithms	5	4	3	2	1	(70)
e.	Express a number as the product of its prime factors	5	4	3	2	1	(71)
f.	Use the addition algorithm with whole numbers, common fractions, and decimal fractions (to 100ths)	5	4	3	2	1	(72)
g.	Use the subtraction algorithm with whole numbers, common fractions and decimal fractions (to 100ths)	5	4	3	2	1	(73)
h.	Use the multiplication algorithm with whole numbers, common fractions and decimal fractions (to whole number x 1000ths)	5	4	3	2	1	(74)
i.	Use the division algorithm with whole numbers	5	4	3	2	1	(75)
j.	Identify and list properties of common three dimensional geometrical forms	5	4	3	2	1	(76)
k.	Identify the circle and its parts	5	4	3	2	1	(77)
l.	Perform experiments involving translations, reflections, rotations and flips	5	4	3	2	1	(78)
m.	Perform investigations and arrive at conclusions related to tiling (tessellations)	5	4	3	2	1	(79)
n.	Use instruments to measure length, area, volume, capacity, mass and temperature in metric units	5	4	3	2	1	(80)
o.	Construct and solve word problems arising out of investigations	5	4	3	2	1	(81)
p.	Interpret graphs	5	4	3	2	1	(82)
q.	Construct graphs	5	4	3	2	1	(83)

140

13 D. IN THE LIST BELOW ARE SOME OF THE LEARNING OUTCOMES ONE MIGHT HAVE FOR A GRADE 7 MATHEMATICS PROGRAM. PLEASE MARK THE ITEMS ACCORDING TO THE IMPORTANCE YOU GIVE EACH:

THE TOTAL GRADE 7 MATHEMATICS PROGRAM SHOULD PREPARE THE STUDENT SO THAT HE/SHE IS ABLE TO:

	Very Important				Not Important	
a. State the value represented by each digit in a multi-digit decimal numeral	5	4	3	2	1	(84)
b. Write a decimal numeral in expanded form using powers of 10 in exponent form	5	4	3	2	1	(85)
c. Perform in the correct order, a calculation involving more than one of the four basic operations	5	4	3	2	1	(86)
d. Perform the operations of addition, subtraction, multiplication and division with whole numbers, common fractions and decimal fractions	5	4	3	2	1	(87)
e. Write a whole number as a product of its prime factors	5	4	3	2	1	(88)
f. Calculate the greatest common factor (GCF) of two or more whole numbers	5	4	3	2	1	(89)
g. Calculate the least common multiple (LCM) of two or more whole numbers	5	4	3	2	1	(90)
h. Write sets of equivalent fractions	5	4	3	2	1	(91)
i. Write a decimal numeral for a fraction numeral and vice versa	5	4	3	2	1	(92)
j. Write a percent numeral for a fraction numeral or a decimal numeral	5	4	3	2	1	(93)
k. Solve simple open sentences	5	4	3	2	1	(94)
l. Use a compass and straight-edge to copy an angle	5	4	3	2	1	(95)
m. Use a compass and straight-edge to bisect an angle	5	4	3	2	1	(96)
n. Identify from a diagram, or draw a diagram illustrating acute, right and obtuse angles	5	4	3	2	1	(97)
o. Use instruments to measure length, area, volume, capacity, mass and temperature in metric units	5	4	3	2	1	(98)
p. Translate word problems into open sentences	5	4	3	2	1	(99)
q. Construct a flow chart to fit a verbal description of an operation or procedure	5	4	3	2	1	(100)
r. Test the appropriateness of an answer to a problem	5	4	3	2	1	(101)
s. Draw or interpret scale diagrams	5	4	3	2	1	(102)
t. Solve problems involving percent	5	4	3	2	1	(103)
u. Calculate perimeters of rectangles and triangles	5	4	3	2	1	(104)

14. PLEASE CATEGORIZE EACH OF THE FOLLOWING LEARNING OUTCOMES ACCORDING TO THE IMPORTANCE YOU ATTACH TO EACH:

UPON GRADUATION FROM SECONDARY SCHOOL, EVERY STUDENT SHOULD BE ABLE TO:

	Essential	Important, but not Essential	Optional	
a. Accurately perform the four basic operations with whole numbers	3	2	1	(105)
b. Accurately perform the four basic operations with common fractions	3	2	1	(106)
c. Accurately perform the four basic operations with decimal fractions	3	2	1	(107)
d. Use the 'basic' formulas for area and volume	3	2	1	(108)
e. Use the Pythagorean theorem	3	2	1	(109)
f. Solve linear equations	3	2	1	(110)
g. Solve quadratic equations	3	2	1	(111)
h. Use the metric units of measurement	3	2	1	(112)
i. Evaluate a given algebraic expression	3	2	1	(113)
j. Recognize and name geometric figures	3	2	1	(114)
k. Apply mathematical knowledge to physical world situations	3	2	1	(115)
l. Apply mathematical knowledge to consumer related situations	3	2	1	(116)

15. DO YOU FEEL STUDENTS SHOULD BE REQUIRED TO TAKE A MATHEMATICS COURSE (ACADEMIC OR NON-ACADEMIC) IN:

	YES	NO	
a. Grade 8 ----------	☐ 1	☐ 2	(117)
b. Grade 9 ----------	☐ 1	☐ 2	(118)
c. Grade 10 ----------	☐ 1	☐ 2	(119)
d. Grade 11 ----------	☐ 1	☐ 2	(120)
e. Grade 12 ----------	☐ 1	☐ 2	(121)

142

PART III

CLASSROOM ORGANIZATION

16. HOW MANY STUDENTS DO YOU HAVE AT PRESENT IN YOUR MATHEMATICS CLASS? (122-123)

☐☐

17. ON THE AVERAGE, HOW MUCH TIME DO YOU SPEND EACH DAY TEACHING MATHEMATICS? [1] (124)

☐☐☐ Minutes (1-3)

18. ON THE AVERAGE, ON HOW MANY DAYS A WEEK DO YOU TEACH MATHEMATICS? (4)

One	☐ 1
Two	☐ 2
Three	☐ 3
Four	☐ 4
Five	☐ 5

19. ON THE AVERAGE, HOW MUCH TIME DO YOU SPEND EACH DAY ON MATHEMATICS LESSONS PREPARATION AND MARKING?

☐☐☐ Minutes (5-7)

20. (MULTIPLE RESPONSE ITEM) WHICH OF THE FOLLOWING DESCRIBE(S) YOUR TEACHING SITUATION?

Self-contained classroom	☐ 1	(8)
Team teaching	☐ 1	(9)
Open area (2 or more classes)	☐ 1	(10)
Shared workload (one teacher takes all the mathematics, another takes all the language arts, etc.)	☐ 1	(11)
Other (please specify)	☐ 1	(12)

_____

_____

_____

_____

_____

21. (MULTIPLE RESPONSE ITEM) WHICH OF THE FOLLOWING DESCRIBE(S) THE WAY IN WHICH YOUR STUDENTS ARE ORGANIZED FOR MATHEMATICS INSTRUCTION?

Ability Groups	☐ 1	(13)
Individualized instruction	☐ 1	(14)
Partially individualized instruction	☐ 1	(15)
Total class instruction	☐ 1	(16)
Other (please specify) _____	☐ 1	(17)

22. GENERALLY SPEAKING, HOW FREQUENTLY DURING THEIR MATHEMATICS INSTRUCTION TIME DO YOUR STUDENTS ENGAGE IN EACH OF THE FOLLOWING ACTIVITIES. CIRCLE THE APPROPRIATE NUMERAL.

		Very Frequently	Frequently	Sometimes	Rarely	Never	
a.	Oral work	5	4	3	2	1	(18)
b.	Individual work	5	4	3	2	1	(19)
c.	Small group work	5	4	3	2	1	(20)
d.	Solving textbook exercises	5	4	3	2	1	(21)
e.	Working on creative mathematics projects	5	4	3	2	1	(22)
f.	Teacher explanation/ demonstration	5	4	3	2	1	(23)
g.	Working at activity centres	5	4	3	2	1	(24)
h.	Drill on basic number facts	5	4	3	2	1	(25)

PART IV

CLASSROOM INSTRUCTION

23. Please rank the following five content areas of mathematics with respect to the amount of time you spend on each in your mathematics class during the school year:

		Most time spent				Least time spent	
a.	Drill on basic number facts	5	4	3	2	1	(26)
b.	Computation	5	4	3	2	1	(27)
c.	Problem solving and applications	5	4	3	2	1	(28)
d.	Geometry	5	4	3	2	1	(29)
e.	Metric measurement	5	4	3	2	1	(30)

24. WHICH OF THE FOLLOWING BEST DESCRIBES YOUR USE OF UNITS OF MEASUREMENT IN YOUR CLASSES OTHER THAN MATHEMATICS CLASS:

Use metric units only	☐	1
Use both metric and British units	☐	2
Use British units only	☐	3
I teach only mathematics classes	☐	4 (31)

25 A. PLEASE RATE THE FOLLOWING RESOURCES WITH RESPECT TO THEIR USEFULNESS IN YOUR PLANNING OF DAY-TO-DAY LESSONS OR UNITS IN MATHEMATICS:

		Very Useful				Not Useful	
a.	Last year's preparation	5	4	3	2	1	(32)
b.	B.C. Mathematics Curriculum Guide	5	4	3	2	1	(33)
c.	B.C.T.F. Lesson Aids	5	4	3	2	1	(34)
d.	Idea books, e.g., Creative Mathematics, Workjobs, Activity-Oriented Mathematics, etc.	5	4	3	2	1	(35)
e.	Ideas from in-service activities	5	4	3	2	1	(36)
f.	Ideas from colleagues	5	4	3	2	1	(37)
g.	Ideas from university courses	5	4	3	2	1	(38)
h.	Materials from your district Resource Centre	5	4	3	2	1	(39)
i.	Professional journals, e.g., The B.C. Teacher, The Arithmetic Teacher, The Instructor, Vector, etc.	5	4	3	2	1	(40)
j.	School district mathematics specialists	5	4	3	2	1	(41)
k.	District supervisors	5	4	3	2	1	(42)
l.	Student's mathematics textbook	5	4	3	2	1	(43)
m.	Teachers' guidebooks accompanying the different mathematics textbooks	5	4	3	2	1	(44)
n.	Locally developed curriculum guides	5	4	3	2	1	(45)
o.	Materials obtained through browsing in teacher stores or other commercial establishments	5	4	3	2	1	(46)

25 B. PLEASE LIST BELOW ANY OTHER RESOURCES THAT YOU FIND PARTICULARLY USEFUL IN YOUR PLANNING OF LESSONS.

_____

_____

_____

26. THE FOLLOWING STATEMENTS REPRESENT A NUMBER OF FACTORS PURPORTED TO AFFECT MATHEMATICS INSTRUCTION. PLEASE RATE EACH FACTOR WITH THE PRIORITY YOU WOULD GIVE IT BASED ON THE EFFECT IT HAS ON THE SUCCESS OF <u>YOUR MATHEMATICS PROGRAM</u>:

		High Priority				Low Priority	
a.	Reduction of class size	5	4	3	2	1	(47)
b.	Greater release time for lesson preparation	5	4	3	2	1	(48)
c.	More clerical assistance	5	4	3	2	1	(49)
d.	Better library services	5	4	3	2	1	(50)
e.	Reduction of total pupil load	5	4	3	2	1	(51)
f.	Improvement of physical facilities	5	4	3	2	1	(52)
g.	Textbooks more suited to instructional needs	5	4	3	2	1	(53)
h.	Increasing time allotment for mathematics	5	4	3	2	1	(54)
i.	More effective teacher education pre-service programs	5	4	3	2	1	(55)
j.	More effective in-service and professional development	5	4	3	2	1	(56)
k.	More release time for in-service and professional development	5	4	3	2	1	(57)
l.	Curriculum guides that offer more assistance in the instructional <u>process</u>	5	4	3	2	1	(58)
m.	Curriculum guides that outline <u>content</u> in specific terms	5	4	3	2	1	(59)
n.	More Learning Assistance Services	5	4	3	2	1	(60)
o.	More mathematics manipulative materials for individual classrooms	5	4	3	2	1	(61)
p.	Ability grouping of students for classes	5	4	3	2	1	(62)

27. PLEASE CIRCLE THE NUMBER WHICH BEST INDICATES THE FREQUENCY WITH WHICH YOU USE EACH OF THE FOLLOWING IN YOUR MATHEMATICS CLASS:

	Frequently	Infrequently	Not at all	
Media				
a. Television	3	2	1	(63)
b. Films	3	2	1	(64)
c. Filmstrips (or loops)	3	2	1	(65)
d. Overhead projector	3	2	1	(66)
e. Opaque projector	3	2	1	(67)
f. Chalk board	3	2	1	(68)
Materials				
g. Hand-held calculators	3	2	1	(69)
h. Commercially prepared handouts	3	2	1	(70)
i. Teacher-prepared handouts	3	2	1	(71)
j. Teacher-prepared games	3	2	1	(72)
k. Teacher-prepared work cards	3	2	1	(73)
l. Base 10 blocks	3	2	1	(74)
m. Cuisenaire rods	3	2	1	(75)
n. Metric equipment	3	2	1	(76)
o. Attribute blocks	3	2	1	(77)
p. Abacus	3	2	1	(78)
q. Sold geometric shapes	3	2	1	(79)
r. Dice	3	2	1	(80)
s. Playing cards	3	2	1	(81)
t. Other (please specify) _____				
Methods				
u. Learning centres	3	2	1	(82)
v. Individualized instruction	3	2	1	(83)
w. Laboratories	3	2	1	(84)
x. Total class instruction	3	2	1	(85)
y. Team teaching	3	2	1	(86)
z. Computer-aided instruction	3	2	1	(87)

28. DO YOU USE A HAND-HELD CALCULATOR IN YOUR OWN WORK?

Yes ---------- ☐ 1

No ---------- ☐ 2 (88)

29. (MULTIPLE RESPONSE ITEM) AT WHICH OF THE FOLLOWING LEVELS DO YOU FEEL STUDENTS SHOULD BE ALLOWED TO USE HAND-HELD CALCULATORS IN THEIR MATHEMATICS CLASSES?

At no level (Go to item 32)	☐ 1	(89)
Primary	☐ 1	(90)
Intermediate	☐ 1	(91)
Junior Secondary	☐ 1	(92)
Senior Secondary	☐ 1	(93)

30. (MULTIPLE RESPONSE ITEM) IN WHICH OF THE FOLLOWING WAYS ARE STUDENTS ALLOWED TO USE HAND-HELD CALCULATORS IN YOUR MATHEMATICS CLASS?

Students do not use hand-held calculators in my mathematics class	☐ 1	(94)
Unrestricted use	☐ 1	(95)
To check work	☐ 1	(96)
To shorten computation time and effort in class work	☐ 1	(97)
To shorten computation time and effort on tests	☐ 1	(98)
To shorten computation time and effort on non-test assignments	☐ 1	(99)
To shorten computation time and effort so that more concepts may be covered	☐ 1	(100)
To shorten computation time and effort so that a concept may be covered in more depth	☐ 1	(101)
To drill on computation facts	☐ 1	(102)
To offer enrichment problems	☐ 1	(103)
Other (please specify)	☐ 1	(104)

_____

31. (MULTIPLE RESPONSE ITEM) IN WHICH OF THE FOLLOWING WAYS DO YOU MAKE USE OF HAND-HELD CALCULATORS IN YOUR MATHEMATICS CLASS?

To do the computation so the concept can be emphasized	☐ 1	(105)
To do the computation so many more examples of a concept may be shown	☐ 1	(106)
To show students how to use hand-held calculators	☐ 1	(107)
Other (please specify)	☐ 1	(108)

_____

32 A. PLEASE MARK THE FOLLOWING EVALUATION TECHNIQUES ACCORDING TO THE IMPORTANCE OF EACH IN YOUR MATHEMATICS PROGRAM:

	Very Important				Not Important	
a. Standardized mathematics tests	5	4	3	2	1	(109)
b. Teacher-prepared tests	5	4	3	2	1	(110)
c. Tests prepared at the school district level	5	4	3	2	1	(111)
d. Tests prepared for use throughout your school	5	4	3	2	1	(112)
e. Performance on day-to-day activities	5	4	3	2	1	(113)
f. Teacher observations of students' work	5	4	3	2	1	(114)
g. Teacher-prepared checklists	5	4	3	2	1	(115)
h. Commercially prepared inventories	5	4	3	2	1	(116)

32 B. PLEASE LIST BELOW ANY OTHER EVALUATION TECHNIQUES YOU THINK ARE IMPORTANT.

_____

_____

_____

33. IS THERE A LEARNING ASSISTANCE CENTRE IN YOUR SCHOOL WHICH OFFERS ASSISTANCE IN MATHEMATICS:

Yes ---------- ☐ 1 (117)
No ---------- ☐ 2

34. IS THERE A RESOURCE PERSON FOR MATHEMATICS AVAILABLE TO YOU AT THE:

a. District Level? Yes ---------- ☐ 1
No ---------- ☐ 2 (118)

b. School Level? Yes ---------- ☐ 1
No ---------- ☐ 2 (119)

35. DOES YOUR SCHOOL HAVE A MATHEMATICS PROGRAM DESIGNED BY THE TEACHERS IN YOUR SCHOOL AS A BASIS FOR MATHEMATICS INSTRUCTION?

Yes ---------- ☐ 1
No ---------- ☐ 2 (120)

PART V

USE OF TEXTBOOKS

36. DO YOU USE AT LEAST ONE MATHEMATICS TEXTBOOK IN YOUR MATHEMATICS CLASS?

Yes	☐ 1	
No (go to last page)	☐ 2	(121)

37. WHICH ONE OF THE FOLLOWING BEST DESCRIBES YOUR USE OF TEXTBOOKS:

I use one basic textbook in my mathematics class	☐ 1	
I use multiple textbooks in my mathematics class, but one is predominantly in use	☐ 2	
I use a fairly even distribution of two or more textbooks in my mathematics class	☐ 3	(122)

38. WHICH OF THE FOLLOWING STATEMENTS BEST DESCRIBES WHAT YOU WOULD PREFER FOR TEXTBOOK PRESCRIPTION:

There should be <u>one</u> prescribed mathematics textbook series	☐ 1	
There should be <u>several</u> recommended mathematics textbook series to allow the teacher to choose freely	☐ 2	
There should be <u>no</u> prescribed mathematics textbook series	☐ 3	
I don't know	☐ 4	(123)

39. THERE SHOULD BE AN OUTLINE OF THE MINIMUM LEARNING OUTCOMES AT EACH LEVEL OR GRADE, TO GUIDE THE TEACHER IN THE SELECTION OF MATHEMATICS TEXTBOOKS, MATERIALS, AND ACTIVITIES.

Agree	☐ 1	
Disagree	☐ 2	
I don't know	☐ 3	(124)

40 A. (MULTIPLE RESPONSE ITEM) <u>GRADE 1, 3 and 5 TEACHERS</u>: WHICH TEXTBOOK(S) DO YOU USE IN YOUR MATHEMATICS CLASS? ☐ 2 (125)

Investigating School Mathematics	☐ 1	(1)
Project Mathematics	☐ 1	(2)
Heath Elementary Mathematics	☐ 1	(3)
Seeing Through Arithmetic	☐ 1	(4)
Other (please specify)_____	☐ 1	(5)

40 B. (MULTIPLE RESPONSE ITEM) GRADE 7 TEACHERS: WHICH TEXTBOOK(S) DO YOU USE IN YOUR MATHEMATICS CLASS?

School Mathematics I	☐ 1	(6)
Mathematics I	☐ 1	(7)
Essentials of Mathematics I	☐ 1	(8)
Contemporary Mathematics, Book I	☐ 1	(9)
Other (please specify) _____	☐ 1	(10)

41. GENERALLY SPEAKING, HOW SATISFACTORY IS/ARE THE TEXTBOOK(S) YOU ARE USING?

Satisfactory	☐ 1	
Not Satisfactory	☐ 2	
Cannot say	☐ 3	(11)

42. GENERALLY SPEAKING, ABOUT HOW MUCH OF THE TEXTUAL MATERIAL -- APART FROM THE EXERCISES -- DO YOUR STUDENTS ACTUALLY READ?

Less than 1 page out of every 5	☐ 1	
1 - 2 pages out of every 5	☐ 2	
3 - 4 pages out of every 5	☐ 3	
5 pages out of every 5	☐ 4	(12)

43. (MULTIPLE RESPONSE ITEM) WHICH OF THE FOLLOWING DESCRIBE(S) HOW YOU USE A TEXTBOOK IN YOUR MATHEMATICS CLASS?

To develop a new concept	☐ 1	(13)
To review concepts developed in class	☐ 1	(14)
To provide exercises for drill and practice	☐ 1	(15)
Other (please specify) _____	☐ 1	(16)

44. WHICH ONE OF THE FOLLOWING BEST DESCRIBES THE KIND OF TEXTBOOK YOU PREFER: A TEXTBOOK WITH:

Great emphasis on skills/drill	☐ 1	
Greater emphasis on skills/drill than concepts/principles	☐ 2	
Equal emphasis on skills/drill and concepts/principles	☐ 3	
Greater emphasis on concepts/principles than skills/drill	☐ 4	
Great emphasis on concepts/principles	☐ 5	(17)

45 A. PLEASE RATE THE FOLLOWING ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR A TEXTBOOK TO DO EACH:

A TEXTBOOK SHOULD ...	Very Important				Not Important	
a ...develop concepts	5	4	3	2	1	(18)
b. ...provide drill and practice	5	4	3	2	1	(19)
c. ...provide enrichment material	5	4	3	2	1	(20)
d. ...motivate the student	5	4	3	2	1	(21)
e. ...provide remedial material	5	4	3	2	1	(22)

45 B. PLEASE LIST BELOW ANYTHING ELSE YOU FEEL A TEXTBOOK SHOULD DO:

_____

_____

_____

46 A. PLEASE RATE THE FOLLOWING ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR THE <u>TEACHERS' EDITION</u> OF A MATHEMATICS TEXTBOOK TO PROVIDE EACH:

THE TEACHERS' EDITION OF A MATHEMATICS TEXTBOOK SHOULD PROVIDE ...

	Very Important				Not Important	
a. ...lesson objectives	5	4	3	2	1	(23)
b. ...suggested discussion for lesson	5	4	3	2	1	(24)
c. ...development of the lesson's mathematics content	5	4	3	2	1	(25)
d. ...exercise answers at end of text	5	4	3	2	1	(26)
e. ...enrichment materials	5	4	3	2	1	(27)
f. ...remediation materials	5	4	3	2	1	(28)
g. ...follow-up activities	5	4	3	2	1	(29)
h. ...suggested resources	5	4	3	2	1	(30)
i. ...achievement tests	5	4	3	2	1	(31)
j. ...diagnostic tests	5	4	3	2	1	(32)
k. ...suggested teaching aids	5	4	3	2	1	(33)
l. ...suggested time allocation for each topic	5	4	3	2	1	(34)
m. ...overprinted answers to exercises (printed throughout the text)	5	4	3	2	1	(35)

46 B. PLEASE LIST BELOW ANYTHING ELSE YOU FEEL A TEACHERS' EDITION OF A MATHEMATICS TEXTBOOK SHOULD PROVIDE:

_____

_____

_____

**********GRADE 7 TEACHERS: GO TO ITEM 51**********

47. GRADE 1, 3 AND 5 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE READING LEVEL OF THE TEXTBOOK.

Textbook	For my class, the reading level is: I Don't Know	Too High	About Right	Too Low	
a. Investigating School Mathematics	9	1	2	3	(36)
b. Project Mathematics	9	1	2	3	(37)
c. Heath Elementary Mathematics	9	1	2	3	(38)

48. GRADE 1, 3 AND 5 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON COMPUTATION WITH WHOLE NUMBERS.

	The textbook stresses computation with whole numbers: I Don't Know	Too Much	About Right	Too Little	
a. Investigating School Mathematics	9	1	2	3	(39)
b. Project Mathematics	9	1	2	3	(40)
c. Heath Elementary Mathematics	9	1	2	3	(41)

49. GRADE 1, 3 AND 5 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON PROBLEM SOLVING:

	The textbook stresses problem solving: I Don't Know	Too Much	About Right	Too Little	
a. Investigating School Mathematics	9	1	2	3	(42)
b. Project Mathematics	9	1	2	3	(43)
c. Heath Elementary Mathematics	9	1	2	3	(44)

50. GRADE 1, 3 AND 5 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON METRIC MEASUREMENT.

	The textbook stresses metric measurement: I Don't Know	Too Much	About Right	Too Little	
a. Investigating School Mathematics	9	1	2	3	(45)
b. Project Mathematics	9	1	2	3	(46)
c. Heath Elementary Mathematics	9	1	2	3	(47)

153

51. GRADE 7 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE READING LEVEL OF THE TEXTBOOK.

	For my class the reading level is:				
	I Don't Know	Too High	About Right	Too Low	
a. School Mathematics I	9	1	2	3	(48)
b. Mathematics I	9	1	2	3	(49)
c. Essentials of Mathematics I	9	1	2	3	(50)

52. GRADE 7 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON COMPUTATION WITH WHOLE NUMBERS.

	The textbook stresses computation with whole numbers:				
	I Don't Know	Too Much	About Right	Too Little	
a. School Mathematics I	9	1	2	3	(51)
b. Mathematics I	9	1	2	3	(52)
c. Essentials of Mathematics I	9	1	2	3	(53)

53. GRADE 7 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON PROBLEM SOLVING.

	The textbook stresses problem solving:				
	I Don't Know	Too Much	About Right	Too Little	
a. School Mathematics I	9	1	2	3	(54)
b. Mathematics I	9	1	2	3	(55)
c. Essentials of Mathematics I	9	1	2	3	(56)

54. GRADE 7 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON METRIC MEASUREMENT.

	The textbook stresses metric measurement:				
	I Don't Know	Too Much	About Right	Too Little	
a. School Mathematics I	9	1	2	3	(57)
b. Mathematics I	9	1	2	3	(58)
c. Essentials of Mathematics I	9	1	2	3	(59)

THANK YOU VERY MUCH for cooperating by giving the time and effort necessary to complete the questionnaire.

If you wish to provide further information concerning your aims, methods, or problems not covered in this questionnaire, please use the space below:

COMMENT:

© Ministry of Education,
Province of British Columbia

APPENDIX B

QUESTIONNAIRE FOR SECONDARY TEACHERS

(1)	(2)	(3)	(4)	(5)

SCHOOL CODE

BRITISH COLUMBIA LEARNING ASSESSMENT PROGRAM

SECONDARY MATHEMATICS

A TEACHER QUESTIONNAIRE

We appreciate the fact that school programs at the present time are so varied that the questions posed here may not fit your school organization or philosophy. Where there is a lack of 'fit' betw en our questions and your organization or philosophy, please specify and comment. Use the last page for more detailed comment. In general, we would ask that you respond as fully as you can.

IMPORTANT

ON THE LABEL ON THE ENVELOPE IN WHICH YOU RECEIVED THIS QUESTIONNAIRE IS MARKED A GRADE/YEAR LEVEL CORRESPONDING TO ONE OF THOSE BELOW. PLEASE CHECK THE APPROPRIATE BOX AND RESPOND TO THE QUESTIONNAIRE WITH THIS ONE LEVEL IN MIND, EVEN THOUGH YOU MAY ALSO TEACH OTHER LEVELS.

Mathematics Grade 8 --------- ☐ 1
Mathematics Grade 10 --------- ☐ 2
Mathematics Grade 12 --------- ☐ 3 (8)

ON SOME ITEMS, MORE THAN ONE CHOICE MAY BE MARKED SUCH ITEMS WILL BE PRECEDED BY '(MULTIPLE RESPONSE ITEM)'.

PLEASE DO NOT USE THIS

PART I

BACKGROUND AND GENERAL INFORMATION

PLEASE CHECK THE APPROPRIATE CATEGORY:

1. YEARS OF POST-SECONDARY EDUCATION AS OF JUNE, 1977:

1	☐ 1	
2	☐ 2	
3	☐ 3	
4	☐ 4	
5	☐ 5	
6 or more	☐ 6	(9)

2. YEARS OF TEACHING EXPERIENCE AS OF JUNE, 1977:

1 or less	☐ 1	
2 - 5	☐ 2	
6 - 9	☐ 3	
10 - 13	☐ 4	
14 or more	☐ 5	(10)

3. (MULTIPLE RESPONSE ITEM) AT WHICH OF THE FOLLOWING LEVELS HAVE YOU TAUGHT?

Primary	☐ 1	(11)
Intermediate	☐ 1	(12)
Junior Secondary	☐ 1	(13)
Senior Secondary	☐ 1	(14)

4. IN YOUR UNDERGRADUATE TRAINING WAS MATHEMATICS ONE OF YOUR MAJOR SUBJECT AREAS?

Yes (Go to item 6)	☐ 1	
No	☐ 2	(15)

5. HAVE YOU COMPLETED AT LEAST ONE COURSE IN MATHEMATICS CONTENT BEYOND SECONDARY GRADUATION?

Yes	☐ 1	
No	☐ 2	(16)

6. HAVE YOU COMPLETED AT LEAST ONE COURSE IN HOW TO TEACH MATHEMATICS (MATHEMATICS METHODS COURSE)?

Yes, more than 10 years ago	☐ 1	
Yes, in the last 10 years	☐ 2	
No	☐ 3	(17)

7. (MULTIPLE RESPONSE ITEM) TO WHICH OF THE FOLLOWING ASSOCIATIONS DO YOU CURRENTLY BELONG?

B.C. Association of Mathematics Teachers	☐ 1	(18)
National Council of Teachers of Mathematics	☐ 1	(19)
Local Mathematics P.S.A.	☐ 1	(20)

8. HAVE YOU ATTENDED A MATHEMATICS SESSION AT A CONFERENCE IN THE LAST THREE YEARS?

Yes	☐ 1	
No	☐ 2	(21)

9. HAVE YOU ATTENDED A WORKSHOP (OTHER THAN AT A CONFERENCE) OR IN-SERVICE DAY IN MATHEMATICS IN THE LAST THREE YEARS?

Yes	☐ 1	
No	☐ 2	(22)

THE FINAL FOUR ITEMS IN PART I ARE CONCERNED WITH MORE THAN THE GRADE/YEAR LEVEL MATHEMATICS CLASS YOU MARKED ON THE COVER OF THIS QUESTIONNAIRE.

10. PLEASE MARK THE SCALE BELOW ACCORDING TO HOW EASY OR DIFFICULT YOU FIND TEACHING MATHEMATICS AT EACH OF THE FOLLOWING GRADE LEVELS?

	No Experience At This Level	Easy to Teach At This Level				Difficult to Teach at This Level	
a. Grade 8	9	5	4	3	2	1	(23)
b. Grade 9	9	5	4	3	2	1	(24)
c. Grade 10	9	5	4	3	2	1	(25)
d. Grade 11	9	5	4	3	2	1	(26)
e. Grade 12	9	5	4	3	2	1	(27)

11. PLEASE MARK THE SCALE BELOW ACCORDING TO WHETHER YOU ENJOY OR DO NOT ENJOY TEACHING MATHEMATICS AT EACH OF THE FOLLOWING GRADE LEVELS:

	No Experience At This Level	Enjoy Teaching At This Level			Do Not Enjoy Teaching At This Level	
a. Grade 8	9	5	4	3	2	1
b. Grade 9	9	5	4	3	2	1
c. Grade 10	9	5	4	3	2	1
d. Grade 11	9	5	4	3	2	1
e. Grade 12	9	5	4	3	2	1

12. PLEASE RATE EACH OF THE FOLLOWING SUBJECT AREAS INDIVIDUALLY ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR A STUDENT'S SUCCESS IN SCHOOL:

	Very Important				Not Important
a. Business Education	5	4	3	2	1
b. English	5	4	3	2	1
c. Fine Arts	5	4	3	2	1
d. Mathematics	5	4	3	2	1
e. Music	5	4	3	2	1
f. Physical Education	5	4	3	2	1
g. Reading	5	4	3	2	1
h. Science	5	4	3	2	1
i. Social Studies	5	4	3	2	1
j. Vocational Education	5	4	3	2	1

13. PLEASE RATE EACH OF THE FOLLOWING SUBJECT AREAS INDIVIDUALLY ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR THE STUDENT'S ADULT LIFE:

	Very Important				Not Important
a. Business Education	5	4	3	2	1
b. English	5	4	3	2	1
c. Fine Arts	5	4	3	2	1
d. Mathematics	5	4	3	2	1
e. Music	5	4	3	2	1
f. Physical Education	5	4	3	2	1
g. Reading	5	4	3	2	1
h. Science	5	4	3	2	1
i. Social Studies	5	4	3	2	1
j. Vocational Education	5	4	3	2	1

**********GRADE 12 TEACHERS: GO TO ITEM 15**********

ITEM 14 HAS TWO PARTS. PLEASE RESPOND TO THE ONE PART THAT IS CONCERNED WITH THE GRADE/YEAR LEVEL YOU MARKED ON THE COVER PAGE. (14A IS FOR GRADE 8 TEACHERS AND 14B IS FOR GRADE 10 TEACHERS)

14 A. IN THE LIST BELOW ARE SOME OF THE LEARNING OUTCOMES ONE MIGHT EXPECT OF A GRADE 8 MATHEMATICS PROGRAM. USING THE SCALE PROVIDED, PLEASE MARK THE ITEMS ACCORDING TO THE IMPORTANCE YOU GIVE EACH.

THE TOTAL GRADE 8 MATHEMATICS PROGRAM SHOULD PREPARE EACH STUDENT SO THAT HE/SHE IS ABLE TO:

		Very Important				Not Important	
a.	Use set notation	5	4	3	2	1	(53)
b.	State the value represented by each digit in a multi-digit decimal numeral	5	4	3	2	1	(54)
c.	Write decimal numerals in expanded form using powers of ten in exponent form	5	4	3	2	1	(55)
d.	Write decimal numerals in scientific notation	5	4	3	2	1	(56)
e.	Perform the four basic operations with whole numbers, common fractions, and decimal fractions	5	4	3	2	1	(57)
f.	Perform the four basic operations with integers	5	4	3	2	1	(58)
g.	Round a decimal numeral to a specified place value	5	4	3	2	1	(59)
h.	Write a whole number as a product of its prime factors	5	4	3	2	1	(60)
i.	Calculate the GCF of two or more numbers	5	4	3	2	1	(61)
j.	Calculate the LCM of two or more numbers	5	4	3	2	1	(62)
k.	Write a decimal numeral, fraction numberal and percent numeral for any number given in one of the three forms	5	4	3	2	1	(63)
l.	Use a table to find the approximate square root of a number	5	4	3	2	1	(64)
m.	Perform, in conventional order, a calculation involving a series of operations	5	4	3	2	1	(65)
n.	Solve simple open sentences	5	4	3	2	1	(66)
o.	Use a compass and straight-edge to bisect an angle and bisect a line segment	5	4	3	2	1	(67)
p.	Use a compass and straight-edge to construct a perpendicular to line from a point not on the line and parallel to a line through a given point	5	4	3	2	1	(68)
q.	Use the Pythagorean theorem to calculate any side a right triangle	5	4	3	2	1	(69)
r.	Translate verbal problems into open sentences	5	4	3	2	1	(70)
s.	Construct a flow chart to fit a verbal description	5	4	3	2	1	(71)
t.	Test the appropriateness of an answer to a problem	5	4	3	2	1	(72)
u.	Draw or interpret scale drawings	5	4	3	2	1	(73)
v.	Solve problems involving percent	5	4	3	2	1	(74)
w.	Calculate perimeters and areas of circles, rectangles and triangles	5	4	3	2	1	(75)

14 B. IN THE LIST BELOW ARE SOME OF THE LEARNING OUTCOMES ONE MIGHT HAVE FOR A GRADE 10 MATHEMATICS PROGRAM. PLEASE MARK THE ITEMS ACCORDING TO THE IMPORTANCE YOU GIVE EACH:

THE TOTAL GRADE 10 MATHEMATICS PROGRAM SHOULD PREPARE THE STUDENT SO THAT HE/SHE IS ABLE TO:

		Very Important				Not Important	
a.	Perform the four basic operations with whole numbers, common fractions, decimal fractions	5	4	3	2	1	(76)
b.	Perform the four basic operations with integers	5	4	3	2	1	(77)
c.	Write a decimal numeral, fraction numeral, and percent numeral for any number given in one of the three forms	5	4	3	2	1	(78)
d.	Distinguish between rational and irrational numbers by their decimal forms	5	4	3	2	1	(79)
e.	Calculate products and quotients using scientific notation	5	4	3	2	1	(80)
f.	Use the axioms of the real numbers	5	4	3	2	1	(81)
g.	Use the laws of exponents in simplifying expressions with integral exponents	5	4	3	2	1	(82)
h.	Add and multiply polynomials	5	4	3	2	1	(83)
i.	Divide a given polynomial by a (linear) binomial	5	4	3	2	1	(84)
j.	Write the square of any binomial as a trinomial	5	4	3	2	1	(85)
k.	Factor a quadratic trinomial	5	4	3	2	1	(86)
l.	Solve systems of linear equations	5	4	3	2	1	(87)
m.	Solve word problems algebraically	5	4	3	2	1	(88)
n.	Given an equation in two variables, graph the equation in the coordinate plane	5	4	3	2	1	(89)
o.	Calculate one side of a right-angled triangle given the other two sides	5	4	3	2	1	(90)
p.	Determine whether two triangles are similar	5	4	3	2	1	(91)
q.	Specify the sine, cosine, and tangent of an acute angle as the ratio of two sides of a right triangle	5	4	3	2	1	(92)
r.	Calculate the resultant vector for two given vectors by a scale diagram	5	4	3	2	1	(93)
s.	Solve problems involving simple interest	5	4	3	2	1	(94)
t.	Explain the meaning of compound interest	5	4	3	2	1	(95)
u.	Explain the nature of annuities	5	4	3	2	1	(96)
v.	Calculate the true rate of interest in instalment payments when given the formula	5	4	3	2	1	(97)
w.	Use elementary BASIC as a programming language to write, execute, and debug simple programs	5	4	3	2	1	(98)

15. IN THE LIST BELOW ARE SOME OF THE LEARNING OUTCOMES FOR THE ELEMENTARY SCHOOL MATHEMATICS PROGRAM ONE MIGHT WANT A STUDENT ENTERING GRADE 8 TO HAVE.
ALL TEACHERS: PLEASE MARK THE ITEMS ACCORDING TO THE IMPORTANCE YOU GIVE EACH.

THE TOTAL ELEMENTARY SCHOOL MATHEMATICS PROGRAM SHOULD PREPARE THE STUDENT SO THAT HE/SHE IS ABLE TO:

	Essential	Important, but not Essential	Optional	
a. State the value represented by each digit in a multi-digit decimal numeral	3	2	1	(99)
b. Write a decimal numeral in expanded form using powers of 10 in exponent form	3	2	1	(100)
c. Perform in the correct order, a calculation involving more than one of the four basic operations	3	2	1	(101)
d. Perform the operations of addition, subtraction, multiplication and division with whole numbers, common fractions, and decimal fractions	3	2	1	(102)
e. Write a whole number as a product of its prime factors	3	2	1	(103)
f. Calculate the greatest common factor (GCF) of two or more whole numbers	3	2	1	(104)
g. Calculate the least common multiple (LCM) of two or more whole numbers	3	2	1	(105)
h. Write sets of equivalent fractions	3	2	1	(106)
i. Write a decimal numeral for a fraction numeral or vice versa	3	2	1	(107)
j. Write a percent numeral for a fraction numeral or a decimal numeral	3	2	1	(108)
k. Solve simple open sentences	3	2	1	(109)
l. Use a compass and straight-edge to copy an angle	3	2	1	(110)
m. Use a compass and straight-edge to bisect an angle	3	2	1	(111)
n. Identify from a diagram, or draw a diagram illustrating acute, right and obtuse angles	3	2	1	(112)
o. Use instruments to measure length, area, volume, capacity, mass, and temperature in metric units	3	2	1	(113)
p. Translate word problems into open sentences	3	2	1	(114)
q. Construct a flow chart to fit a verbal description	3	2	1	(115)
r. Test the appropriateness of an answer to a problem	3	2	1	(116)
s. Draw or interpret scale diagrams	3	2	1	(117)
t. Solve problems involving percent	3	2	1	(118)
u. Calculate perimeters of rectangles and triangles	3	2	1	(119)

164

16. ALL TEACHERS: PLEASE CATEGORIZE EACH OF THE FOLLOWING LEARNING OUTCOMES ACCORDING TO THE IMPORTANCE YOU ATTACH TO EACH.

UPON GRADUATION FROM SECONDARY SCHOOL, EVERY STUDENT SHOULD BE ABLE TO:

	Essential	Important, but not Essential	Optional	
a. Accurately perform the four basic operations with whole numbers	3	2	1	(120)
b. Accurately perform the four basic operations with common fractions	3	2	1	(121)
c. Accurately perform the four basic operations with decimal fractions	3	2	1	(122)
d. Use the 'basic' formulas for area and volume	3	2	1	(123)
e. Use the Pythagorean theorem	3	2	1	(124) 1 (125)
f. Solve linear equations	3	2	1	(1)
g. Solve quadratic equations	3	2	1	(2)
h. Use the metric units of measurement	3	2	1	(3)
i. Evaluate a given algebraic expression	3	2	1	(4)
j. Recognize and name geometric figures	3	2	1	(5)
k. Apply mathematical knowledge to physical world situations	3	2	1	(6)
l. Apply mathematical knowledge to consumer related situations	3	2	1	(7)

17. DO YOU FEEL STUDENTS SHOULD BE REQUIRED TO TAKE A MATHEMATICS COURSE (ACADEMIC OR NON-ACADEMIC) IN:

	YES	NO	
a. Grade 8	☐ 1	☐ 2	(8)
b. Grade 9	☐ 1	☐ 2	(9)
c. Grade 10	☐ 1	☐ 2	(10)
d. Grade 11	☐ 1	☐ 2	(11)
e. Grade 12	☐ 1	☐ 2	(12)

PART III

CLASSROOM ORGANIZATION

18. ON THE AVERAGE, HOW MANY STUDENTS DO YOU CURRENTLY HAVE IN THE MATHEMATICS CLASS(ES) AT THE GRADE/YEAR LEVEL SPECIFIED EARLIER?

☐☐ (13,14)

19. ON THE AVERAGE, HOW MUCH TIME DO YOU SPEND EACH DAY TEACHING MATHEMATICS?

☐☐☐ Minutes (15-17)

20. ON THE AVERAGE, HOW MUCH TIME DO YOU SPEND EACH DAY TEACHING NON-MATHEMATICS COURSES?

☐☐☐ Minutes (18-20)

21. ON THE AVERAGE, HOW MUCH TIME DO YOU SPEND EACH DAY ON MATHEMATICS LESSON PREPARATION?

☐☐☐ Minutes (21-23)

22. ON THE AVERAGE, ON HOW MANY DAYS A WEEK DO YOU TEACH MATHEMATICS?

One	☐	1
Two	☐	2
Three	☐	3
Four	☐	4
Five	☐	5

(24)

23. ON THE AVERAGE, HOW MUCH TIME DO YOU SPEND EACH DAY GRADING MATHEMATICS ASSIGNMENTS?

☐☐☐ Minutes (25-27)

24. (MULTIPLE RESPONSE ITEM) WHICH OF THE FOLLOWING DESCRIBE(S) YOUR TEACHING SITUATION?

Self-contained classroom	☐	1	(28)
Team teaching	☐	1	(29)
Open area (two or more classes)	☐	1	(30)
Other (please specify)	☐	1	(31)

_____

25. (MULTIPLE RESPONSE ITEM) WHICH OF THE FOLLOWING DESCRIBE(S) THE WAY IN WHICH YOUR STUDENTS ARE ORGANIZED FOR MATHEMATICS INSTRUCTION?

Ability groups	☐ 1	(32)
Individualized instruction	☐ 1	(33)
Partially individualized instruction	☐ 1	(34)
Total class instruction	☐ 1	(35)
Other (please specify) _____	☐ 1	(36)

26. GENERALLY SPEAKING, HOW FREQUENTLY DURING THE MATHEMATICS INSTRUCTION TIME DO YOUR STUDENTS ENGAGE IN EACH OF THE FOLLOWING ACTIVITIES?

		Very Frequently	Frequently	Sometimes	Rarely	Never	
a.	Oral work	5	4	3	2	1	(37)
b.	Individual work	5	4	3	2	1	(38)
c.	Small group work	5	4	3	2	1	(39)
d.	Solving textbook exercises	5	4	3	2	1	(40)
e.	Working on creative mathematics projects	5	4	3	2	1	(41)
f.	Teacher explanation/ demonstration	5	4	3	2	1	(42)
g.	Working at activity centres	5	4	3	2	1	(43)
h.	Drill on arithmetic computation	5	4	3	2	1	(44)

PART IV
CLASSROOM INSTRUCTION

27. PLEASE RANK THE FOLLOWING FIVE CONTENT AREAS OF MATHEMATICS WITH RESPECT TO THE AMOUNT OF TIME YOU SPEND ON EACH IN YOUR MATHEMATICS CLASS DURING THE SCHOOL YEAR:

		Most Time Spent				Least Time Spent	
a.	Drill on arithmetic computation	5	4	3	2	1	(45)
b.	Problem solving and applications	5	4	3	2	1	(46)
c.	Geometry	5	4	3	2	1	(47)
d.	Metric measurement	5	4	3	2	1	(48)
e.	Algebraic concepts	5	4	3	2	1	(49)

28. WHICH OF THE FOLLOWING BEST DESCRIBES YOUR USE OF UNITS OF MEASUREMENT IN YOUR CLASSES?

Use metric units only	☐ 1	
Use both metric and British units	☐ 2	
Use British units only	☐ 3	(50)

29 A. PLEASE RATE THE FOLLOWING RESOURCES WITH RESPECT TO THEIR USEFULNESS IN YOUR PLANNING OF DAY-TO-DAY LESSONS OR UNITS IN MATHEMATICS:

		Very Useful				Not Useful	
a.	Last year's preparation	5	4	3	2	1	(51)
b.	B.C. Mathematics Curriculum Guide	5	4	3	2	1	(52)
c.	B.C.T.F. Lesson Aids	5	4	3	2	1	(53)
d.	The provincially adopted textbooks for the students	5	4	3	2	1	(54)
e.	The teachers' guidebook accompanying the provincially adopted textbooks	5	4	3	2	1	(55)
f.	Mathematics books which are not provincially adopted	5	4	3	2	1	(56)
g.	Mathematics books which are not textbooks	5	4	3	2	1	(57)
h.	Ideas from in-service programs	5	4	3	2	1	(58)
i.	Ideas from university courses	5	4	3	2	1	(59)
j.	Materials from your district Resource Centre	5	4	3	2	1	(60)
k.	Professional journals; e.g., The B.C. Teacher, The Mathematics Teacher, Vector, etc.	5	4	3	2	1	(61)
l.	School district mathematics specialists	5	4	3	2	1	(62)
m.	District supervisors	5	4	3	2	1	(63)
n.	Locally developed curriculum guides	5	4	3	2	1	(64)
o.	Material obtained through browsing in teacher stores or other commercial establishments	5	4	3	2	1	(65)

29 B. PLEASE LIST BELOW ANY OTHER RESOURCES YOU FIND USEFUL IN YOUR LESSON PLANNING:

_____

_____

_____

30. PLEASE CIRCLE THE NUMBER WHICH BEST INDICATES THE FREQUENCY WITH WHICH YOU USE EACH OF THE FOLLOWING IN YOUR MATHEMATICS CLASS:

Media		Frequently	Infrequently	Not At All	
a.	Television	3	2	1	(66)
b.	Films	3	2	1	(67)
c.	Filmstrips (or loops)	3	2	1	(68)
d.	Overhead projector	3	2	1	(69)
e.	Opaque projector	3	2	1	(70)
f.	Chalk board	3	2	1	(71)

30. Materials	Frequently	Infrequently	Not At All	
g. Hand-held calculators	3	2	1	(72)
h. Commercially prepared handouts	3	2	1	(73)
i. Teacher-prepared handouts	3	2	1	(74)
j. Teacher-prepared games	3	2	1	(75)
k. Teacher-prepared work cards	3	2	1	(76)
l. Metric equipment	3	2	1	(77)
m. Computer	3	2	1	(78)
n. Slide rules	3	2	1	(79)
o. Other (please specify)				
_____				
Methods				
p. Learning centres	3	2	1	(80)
q. Individualized instruction	3	2	1	(81)
r. Laboratories	3	2	1	(82)
s. Total class instruction	3	2	1	(83)
t. Team teaching	3	2	1	(84)
u. Computer aided instruction	3	2	1	(85)

31. THE FOLLOWING STATEMENTS REPRESENT A NUMBER OF FACTORS PURPORTED TO AFFECT MATHEMATICS INSTRUCTION. PLEASE RATE EACH FACTOR WITH THE PRIORITY YOU WOULD GIVE IT BASED ON THE EFFECT IT HAS ON THE SUCCESS OF YOUR MATHEMATICS PROGRAM.

	High Priority				Low Priority	
a. Reduction of class size	5	4	3	2	1	(86)
b. Greater release time for lesson preparation	5	4	3	2	1	(87)
c. More clerical assistance	5	4	3	2	1	(88)
d. Better library services	5	4	3	2	1	(89)
e. Reduction of total pupil load	5	4	3	2	1	(90)
f. Improvement of physical facilities	5	4	3	2	1	(91)
g. Textbooks more suited to instructional needs	5	4	3	2	1	(92)
h. Increasing time allotment for mathematics	5	4	3	2	1	(93)
i. More effective teacher education pre-service programs	5	4	3	2	1	(94)
j. More effective in-service and professional development	5	4	3	2	1	(95)
k. More release time for in-service and professional development	5	4	3	2	1	(96)
l. Curriculum guides that offer more assistance in the instructional process	5	4	3	2	1	(97)
m. Curriculum guides that outline content in specific terms	5	4	3	2	1	(98)
n. More Learning Assistance services	5	4	3	2	1	(99)
o. More mathematics manipulative materials for individual classrooms	5	4	3	2	1	(100)
p. Ability grouping of students for classes	5	4	3	2	1	(101)

169

32. (MULTIPLE RESPONSE ITEM) IN WHICH OF THE FOLLOWING WAYS IS A COMPUTER USED IN YOUR SCHOOL FOR INSTRUCTIONAL PURPOSES?

A computer is NOT used in the school (Go to Item 34)------	☐ 1	(102)
A computer is used by a computer club or other extra-cirricular organization ----------	☐ 1	(103)
A computer is used in some mathematics classes ----------	☐ 1	(104)
A computer is used in some non-mathematics classes -------	☐ 1	(105)
A computer is used in a computer science course ----------	☐ 1	(106)
Other (please specify) ----------	☐ 1	(107)

33. (MULTIPLE RESPONSE ITEM) IN WHICH OF THE FOLLOWING WAYS DO YOU MAKE USE OF THE COMPUTER IN YOUR MATHEMATICS CLASS?

Students do not use a computer in my mathematics class --	☐ 1	(108)
Students take a computer programming unit in my mathematics course ----------	☐ 1	(109)
Students 'run' pre-written programs ----------	☐ 1	(110)
Students use the computer to solve problems that are part of my mathematics course ----------	☐ 1	(111)
Students do projects using the computer ----------	☐ 1	(112)
Other (please specify) ----------	☐ 1	(113)

34. DO YOU USE A HAND-HELD CALCULATOR IN YOUR OWN WORK?

Yes ----------	☐ 1	
No ----------	☐ 2	(114)

35. (MULTIPLE RESPONSE ITEM) AT WHICH OF THE FOLLOWING LEVELS DO YOU FEEL STUDENTS SHOULD BE ALLOWED TO USE HAND-HELD CALCULATORS IN THEIR MATHEMATICS CLASSES?

At no level (Go to Item 38) ----------	☐ 1	(115)
Primary ----------	☐ 1	(116)
Intermediate ----------	☐ 1	(117)
Junior Secondary ----------	☐ 1	(118)
Senior Secondary ----------	☐ 1	(119)

36. (MULTIPLE RESPONSE ITEM) IN WHICH OF THE FOLLOWING WAYS ARE STUDENTS ALLOWED TO USE HAND-HELD CALCULATORS IN YOUR MATHEMATICS CLASS?

Students do not use hand-held calculators in my mathematics class	☐ 1	(120)
Unrestricted use	☐ 1	(121)
To check work	☐ 1	(122)
To shorten computation time and effort in class work	☐ 1	(123)
To shorten computation time and effort on tests	☐ 1	(124)
To shorten computation time and effort on non-test assignments	☐ 1	(125)
To shorten computation time and effort so that more concepts may be covered	☐ 1	(1)
To shorten computation time and effort so that a concept may be covered in more depth	☐ 1	(2)
To drill on computation facts	☐ 1	(3)
To offer enrichment problems	☐ 1	(4)
Other (please specify)	☐ 1	(5)
		(6)

_____

37. (MULTIPLE RESPONSE ITEM) IN WHICH OF THE FOLLOWING WAYS DO YOU MAKE USE OF HAND-HELD CALCULATORS IN YOUR MATHEMATICS CLASS?

To do the computation so the concept can be emphasized	☐ 1	(7)
To do the computation so many more examples of a concept may be shown	☐ 1	(8)
To show students how to use hand-held calculators	☐ 1	(9)
Other (please specify)	☐ 1	(10)

_____

38 A. PLEASE MARK THE FOLLOWING EVALUATION TECHNIQUES ACCORDING TO THE IMPORTANCE OF EACH IN YOUR MATHEMATICS PROGRAM:

	Very Important				Not Important	
a. Standardized mathematics tests	5	4	3	2	1	(11)
b. Teacher-prepared tests	5	4	3	2	1	(12)
c. Tests prepared at the school district level	5	4	3	2	1	(13)
d. Tests prepared for use throughout your school	5	4	3	2	1	(14)
e. Performance on assignments	5	4	3	2	1	(15)
f. Teacher observations of students' work	5	4	3	2	1	(16)
g. Teacher-prepared checklists	5	4	3	2	1	(17)
h. Commercially prepared inventories	5	4	3	2	1	(18)

38 B. PLEASE LIST BELOW ANY OTHER EVALUATION TECHNIQUES YOU FEEL ARE IMPORTANT:

_____

_____

_____

171

39. IS THERE A LEARNING ASSISTANCE CENTRE IN YOUR SCHOOL WHICH OFFERS ASSISTANCE IN MATHEMATICS?

Yes	☐ 1	(19)
No	☐ 2	

40. IS THERE A RESOURCE PERSON FOR MATHEMATICS AVAILABLE TO YOU AT THE:

a. District level?	Yes	☐ 1	
	No	☐ 2	(20)
b. School level?	Yes	☐ 1	
	No	☐ 2	(21)

41. DOES YOUR SCHOOL HAVE A MATHEMATICS PROGRAM DESIGNED BY THE TEACHERS IN YOUR SCHOOL AS A BASIS FOR MATHEMATICS INSTRUCTION?

Yes	☐ 1	
No	☐ 2	(22)

42. ON THE AVERAGE, ABOUT HOW MUCH OUT-OF-CLASS TIME DO YOU FEEL YOUR STUDENTS SHOULD SPEND ON YOUR MATHEMATICS ASSIGNMENTS?

None at all	☐ 1	
Less than 30 minutes per day	☐ 2	
30 - 60 minutes per day	☐ 3	
More than an hour per day	☐ 4	(23)

PART V

USE OF TEXTBOOK

43. DO YOU USE AT LEAST ONE MATHEMATICS TEXTBOOK IN YOUR MATHEMATICS CLASS?

Yes (Go to the final statement on the last page)	☐ 1	
No	☐ 2	(24)

44. WHICH ONE OF THE FOLLOWING BEST DESCRIBES YOUR USE OF TEXTBOOKS:

I use one basic textbook in my mathematics class	☐ 1	
I use multiple textbooks in my mathematics class, but one is predominantly in use	☐ 2	
I use a fairly even distribution of two or more textbooks in my mathematics class	☐ 3	(25)

45. WHICH OF THE FOLLOWING STATEMENTS BEST DESCRIBES WHAT YOU WOULD PREFER FOR TEXTBOOK PRESCRIPTION:

There should be one prescribed mathematics textbook series	☐ 1	
There should be several recommended mathematics textbook series to allow the teacher to choose freely	☐ 2	
There should be no prescribed mathematics textbook series	☐ 3	
I don't know	☐ 4	(26)

172

46. THERE SHOULD BE AN OUTLINE OF THE MINIMUM LEARNING OUTCOMES AT EACH LEVEL OR GRADE, TO GUIDE THE TEACHER IN THE SELECTION OF MATHEMATICS TEXTBOOKS, MATERIALS AND ACTIVITIES.

Agree	☐ 1	
Disagree	☐ 2	
I don't know	☐ 3	(27)

ITEM 47 HAS THREE PARTS. PLEASE RESPOND TO THE ONE PART THAT IS CONCERNED WITH THE GRADE LEVEL YOU MARKED ON THE COVER PAGE.

47 A is for GRADE 8 TEACHERS

47 B is for GRADE 10 TEACHERS

47 C is for GRADE 12 TEACHERS

47 A. (MULTIPLE RESPONSE ITEMS) GRADE 8 TEACHERS: WHICH TEXTBOOK(S) DO YOU USE IN YOUR MATHEMATICS CLASS(ES)?

1.	School Mathematics II	☐ 1	(28)
2.	Mathematics II	☐ 1	(29)
3.	Essentials of Mathematics II	☐ 1	(30)
4.	Fundamental Concepts of Elementary Mathematics	☐ 1	(31)
5.	Other (please specify)	☐ 1	(32)

_____

47 B. (MULTIPLE RESPONSE ITEMS) GRADE 10 TEACHERS: WHICH TEXTBOOK(S) DO YOU USE IN YOUR MATHEMATICS CLASS(ES)?

6.	Mathematics for a Modern World, Book 2	☐ 1	(33)
7.	Geometry	☐ 1	(34)
8.	Mathematics: A Modern Approach	☐ 1	(35)
9.	Trouble-Shooting Mathematics Skills	☐ 1	(36)
10.	Essentials of Mathematics 3	☐ 1	(37)
11.	Modern Algebra, Book I - Modules 4, 5, 6	☐ 1	(38)
12.	Mathematical Pursuits Two	☐ 1	(39)
13.	Business and Consumer Mathematics	☐ 1	(40)
14.	Career Mathematics, Industry and Trade	☐ 1	(41)
15.	Other (please specify)	☐ 1	(42)

_____

47 C. (MULTIPLE RESPONSE ITEMS) GRADE 12 TEACHERS: WHICH TEXTBOOK(S) DO YOU USE IN YOUR MATHEMATICS CLASS(ES)?

16. Modern Algebra and Trigonometry, Book 2 ----------	☐ 1	(43)
17. Introduction to Calculus ----------	☐ 1	(44)
18. Mathematics for a Modern World 1112 ----------	☐ 1	(45)
19. Using Advanced Algebra ----------	☐ 1	(46)
20. Pre-Calculus Mathematics ----------	☐ 1	(47)
21. Other (please specify) ----------	☐ 1	(48)

_____

48. GENERALLY SPEAKING, HOW SATISFACTORY IS/ARE THE TEXTBOOK(S) YOU ARE USING?

Satisfactory ----------	☐ 1	
Not Satisfactory ----------	☐ 2	
Cannot say ----------	☐ 3	(49)

49. GENERALLY SPEAKING, ABOUT HOW MUCH OF THE TEXTUAL MATERIAL -- APART FROM THE EXERCISES -- DO YOUR STUDENTS ACTUALLY READ?

Less than 1 page out of every 5 ----------	☐ 1	
1 - 2 pages out of every 5 ----------	☐ 2	
3 -4 pages out of every 5 ----------	☐ 3	
5 pages out of every 5 ----------	☐ 4	(50)

50. (MULTIPLE RESPONSE ITEM) WHICH OF THE FOLLOWING DESCRIBE(S) HOW YOU USE A TEXTBOOK IN YOUR MATHEMATICS CLASS?

To develop a new concept ----------	☐ 1	(51)
To review concepts developed in class ----------	☐ 1	(52)
To provide exercises for drill and practice ----------	☐ 1	(53)
Other (please specify) ----------	☐ 1	(54)

_____

51. WHICH ONE OF THE FOLLOWING BEST DESCRIBES THE KIND OF TEXTBOOK YOU PREFER?

A TEXTBOOK WITH:

Great emphasis on skills/drill ----------	☐ 1	
Greater emphasis on skills/drill than concepts/principles---	☐ 2	
Equal emphasis on skills/drill and concepts/principles -----	☐ 3	
Greater emphasis on concepts/principles than skills/drill --	☐ 4	
Great emphasis on concepts/principles ----------	☐ 5	(55)

174

52 A. PLEASE RATE THE FOLLOWING ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR A TEXTBOOK TO DO EACH.

A TEXTBOOK SHOULD ...	Very Important				Not Important	
a. Develop concepts	5	4	3	2	1	(56)
b. Reinforce skills	5	4	3	2	1	(57)
c. Provide drill and practice	5	4	3	2	1	(58)
d. Provide enrichment materials	5	4	3	2	1	(59)
e. Motivate the student	5	4	3	2	1	(60)
f. Provide remedial material	5	4	3	2	1	(61)

52 B. PLEASE LIST BELOW ANYTHING ELSE YOU THINK A TEXTBOOK SHOULD DO:

_____

_____

_____

53 A. PLEASE RATE THE FOLLOWING ACCORDING TO HOW IMPORTANT YOU FEEL IT IS FOR THE TEACHERS' EDITION OF A MATHEMATICS TEXTBOOK TO PROVIDE EACH.

THE TEACHERS' EDITION OF A MATHEMATICS TEXTBOOK SHOULD PROVIDE ...	Very Important				Not Important	
a. Lesson objectives	5	4	3	2	1	(62)
b. Suggested discussion for lesson	5	4	3	2	1	(63)
c. Development of the lesson's mathematics content	5	4	3	2	1	(64)
d. Exercise answers at the end of the text	5	4	3	2	1	(65)
e. Enrichment materials	5	4	3	2	1	(66)
f. Remediation materials	5	4	3	2	1	(67)
g. Follow-up activities	5	4	3	2	1	(68)
h. Suggested resources	5	4	3	2	1	(69)
i. Achievement tests	5	4	3	2	1	(70)
j. Diagnostic tests	5	4	3	2	1	(71)
k. Suggested teaching aids	5	4	3	2	1	(72)
l. Suggested time allocation for each topic	5	4	3	2	1	(73)
m. Overprinted exercise answers (printed throughout the text)	5	4	3	2	1	(74)

53 B. PLEASE LIST BELOW ANYTHING ELSE YOU FEEL A TEACHERS' EDITION OF A MATHEMATICS TEXTBOOK SHOULD PROVIDE.

_____

_____

_____

175

GRADE 8 TEACHERS PLEASE RESPOND TO ITEMS 54 - 57

GRADE 10 TEACHERS RESPOND TO ITEMS 58 - 61

GRADE 12 TEACHERS RESPOND TO ITEMS 62 - 65

54. GRADE 8 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE READING LEVEL OF THE TEXTBOOK.

FOR MY CLASS, THE READING LEVEL IS:

	Cannot Say	Too High	About Right	Too Low	
a. School Mathematics II	9	1	2	3	(75)
b. Mathematics II	9	1	2	3	(76)
c. Essentials of Mathematics II	9	1	2	3	(77)

55. GRADE 8 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON COMPUTATION.

THIS TEXTBOOK STRESSES COMPUTATION:

	Cannot Say	Too Much	About Right	Too Little	
a. School Mathematics II	9	1	2	3	(78)
b. Mathematics II	9	1	2	3	(79)
c. Essentials of Mathematics II	9	1	2	3	(80)

56. GRADE 8 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON PROBLEM SOLVING.

THIS TEXTBOOK STRESSES PROBLEM SOLVING:

	Cannot Say	Too Much	About Right	Too Little	
a. School Mathematics II	9	1	2	3	(81)
b. Mathematics II	9	1	2	3	(82)
c. Essentials of Mathematics II	9	1	2	3	(83)

57. GRADE 8 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON ENRICHMENT.

THIS TEXTBOOK STRESSES ENRICHMENT:

	Cannot Say	Too Much	About Right	Too Little	
a. School Mathematics II	9	1	2	3	(84)
b. Mathematics II	9	1	2	3	(85)
c. Essentials of Mathematics II	9	1	2	3	(86)

58. GRADE 10 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE READING LEVEL OF THE TEXTBOOK.

		FOR MY CLASS, THE READING LEVEL IS:				
		Cannot Say	Too High	About Right	Too Low	
a.	Mathematics for a Modern World	9	1	2	3	(87)
b.	Geometry	9	1	2	3	(88)
c.	Mathematics: A Modern Approach	9	1	2	3	(89)
d.	Trouble Shooting Mathematics Skills	9	1	2	3	(90)
e.	Essentials of Mathematics 3	9	1	2	3	(91)
f.	Modern Algebra, Book I- Modules 4 - 6	9	1	2	3	(92)
g.	Mathematical Pursuits Two	9	1	2	3	(93)
h.	Business and Consumer Mathematics	9	1	2	3	(94)
i.	Career Mathematics, Industry and Trade	9	1	2	3	(95)

59. GRADE 10 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON COMPUTATION.

		THIS TEXTBOOK STRESSES COMPUTATION:				
		Cannot Say	Too Much	About Right	Too Little	
a.	Mathematics for a Modern World	9	1	2	3	(96)
b.	Geometry	9	1	2	3	(97)
c.	Mathematics: A Modern Approach	9	1	2	3	(98)
d.	Trouble Shooting Mathematics Skills	9	1	2	3	(99)
e.	Essentials of Mathematics 3	9	1	2	3	(100)
f.	Modern Algebra, Book I - Modules 4 - 6	9	1	2	3	(101)
g.	Mathematics Pursuits Two	9	1	2	3	(102)
h.	Business and Consumer Mathematics	9	1	2	3	(103)
i.	Career Mathematics, Industry and Trade	9	1	2	3	(104)

177

60. GRADE 10 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON PROBLEM SOLVING.

	THIS TEXTBOOK STRESSES PROBLEM SOLVING:				
	Cannot Say	Too Much	About Right	Too Little	
a. Mathematics for a Modern World	9	1	2	3	(105)
b. Geometry	9	1	2	3	(106)
c. Mathematics: A Modern Approach	9	1	2	3	(107)
d. Trouble Shooting Mathematics Skills	9	1	2	3	(108)
e. Essentials of Mathematics 3	9	1	2	3	(109)
f. Modern Algebra I, Modules 4 - 6	9	1	2	3	(110)
g. Mathematical Pursuits Two	9	1	2	3	(111)
h. Business and Consumer Mathematics	9	1	2	3	(112)
i. Career Mathematics, Industry and Trade	9	1	2	3	(113)

61. GRADE 10 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON ENRICHMENT.

	THIS TEXTBOOK STRESSES ENRICHMENT:				
	Cannot Say	Too Much	About Right	Too Little	
a. Mathematics for a Modern World	9	1	2	3	(114)
b. Geometry	9	1	2	3	(115)
c. Mathematics: A Modern Approach	9	1	2	3	(116)
d. Trouble Shooting Mathematics Skills	9	1	2	3	(117)
e. Essentials of Mathematics 3	9	1	2	3	(118)
f. Modern Algebra I, Modules 4 - 6	9	1	2	3	(119)
g. Mathematical Pursuits Two	9	1	2	3	(120)
h. Business and Consumer Mathematics	9	1	2	3	(121)
i. Career Mathematics, Industry and Trade	9	1	2	3	(122)

62. GRADE 12 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE READING LEVEL OF THE TEXTBOOK.

	FOR MY CLASS, THE READING LEVEL IS:				
	Cannot Say	Too High	About Right	Too Low	
a. Modern Algebra and Trigonometry II	9	1	2	3	(123)
b. Introduction to Calculus	9	1	2	3	(124)
					3 (125)
c. Mathematics for a Modern World 1112	9	1	2	3	(1)
d. Using Advanced Algebra	9	1	2	3	(2)
e. Pre-Calculus Mathematics	9	1	2	3	(3)

63. GRADE 12 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON COMPUTATION.

	THE TEXTBOOK STRESSES COMPUTATION:				
	Cannot Say	Too Much	About Right	Too Little	
a. Modern Algebra and Trigonometry II	9	1	2	3	(4)
b. Introduction to Calculus	9	1	2	3	(5)
c. Mathematics for a Modern World 1112	9	1	2	3	(6)
d. Using Advanced Algebra	9	1	2	3	(7)
e. Pre-Calculus Mathematics	9	1	2	3	(8)

64. GRADE 12 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON PROBLEM SOLVING.

	THE TEXTBOOK STRESSES PROBLEM SOLVING:				
	Cannot Say	Too Much	About Right	Too Little	
a. Modern Algebra and Trigonometry II	9	1	2	3	(9)
b. Introduction to Calculus	9	1	2	3	(10)
c. Mathematics for a Modern World 1112	9	1	2	3	(11)
d. Using Advanced Algebra	9	1	2	3	(12)
e. Pre-Calculus Mathematics	9	1	2	3	(13)

65. GRADE 12 TEACHERS: PLEASE MARK EACH OF THE TEXTBOOKS LISTED BELOW WITH RESPECT TO THE TEXTBOOK'S STRESS ON ENRICHMENT.

	THE TEXTBOOK STRESSES ENRICHMENT:				
	Cannot Say	Too Much	About Right	Too Little	
a. Modern Algebra and Trigonometry II	9	1	2	3	(14)
b. Introduction to Calculus	9	1	2	3	(15)
c. Mathematics for a Modern World 1112	9	1	2	3	(16)
d. Using Advanced Algebra	9	1	2	3	(17)
e. Pre-Calculus Mathematics	9	1	2	3	(18)

THANK YOU VERY MUCH for cooperating by giving the time and effort necessary to complete the questionnaire.

If you wish to provide further information concerning your aims, methods, or problems not covered in this questionnaire, please use the space below.

COMMENTS:

[illegible] QUEEN'S PRINTER, VICTORIA, BRITISH COLUMBIA